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NEW YORK, SATURDAY, OCTOBER, 26, 1907.

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THE MARCONI ACHIEVEMENT.

He must, indeed, be of a grudging temperament who does not congratulate Mr. Marconi on his achievement in establishing commercial wireless telegraphy across the Atlantic. This is one of the great new achievements of the new century, and like other deeds, has been attended by doubt, disaster, delay and difficulty. But the spirit and ability of the inventor have risen superior to every fresh trial, and without any boasting, in quiet persistence and endurance, he has worked onward to his goal, the conquest of the ether for the transmission of intelligence.

It is needless for us to add that all the obstacles in the way of a perfect service have not been removed; nor, on the other hand, have all the advances and perfections yet been attained. Mr. Edison, in his generous endorsement of a great rival, says that Mr. Marconi is likely in ten years to send 1000 words a minute. But there may meantime be interruptions of the service, as there have been with cables. Litigations, or at least international disputes as to "control" of the ether, are sure to spring up. The financial side of the art is not yet clearly defined. The London *Economist* figures out that 3,000,000 words will not pay, but it looks to us already like a much higher transmissive ability than that. After all is said and done, the drift of events and invention is with Mr. Marconi, who has now added so immeasurably to the world's resources, yet in a sense uses nothing up in doing so. We trust that Mr. Marconi will give American electrical engineers an early opportunity of offering him in person their hearty felicitations on his splendid work, just as they did when first he jumped the signal "s" across the broad ocean in 1901.

THE COPPER CRASH.

The long expected crash in copper has come at last, developing other troubles in turn, so that New York has had a most anxious and disturbed week. Stock values have crumbled away, financial institutions have been in trouble, public confidence has been broken, and the whole machinery of banking and commerce has been put out of proper running order. Fortunately the prolonged depression of the past spring and summer had already resulted in a healthy check to speculation or over production. It is distressful to think of what might have happened had such a storm burst two years ago, when every inch of canvas was spread. But for some time past, prudent men have limited their purchases and their commitments, and it is evident that the days of soundness and sanity will soon be here again, when business will be conducted on a normal basis, and honesty will be accepted once more as the best policy—even in high places.

Out of all this hurly-burly comes good, and this week we have heard but one note—that of rejoicing—as to copper. A price of 12 or 13 cents may be low, but it is at least nearer real true values than the absurd price of 25 cents marked up by gamblers and cornerers as the point to which public necessity and endurance could be stretched. It will be a long time before

25-cent copper is seen again, and when it is ever seen it will mark actual relations of supply and demand and not an outrageous exaction by artificial monopoly. The electrical industries as a whole breathe more freely at their escape from such an intolerable tax, and have no sympathy with the men who, in overreaching themselves, have sustained losses reported to be so heavy. Our knowledge of the situation and conditions goes to satisfy us that the larger electrical interests were never exposed to the higher range of price demanded, but we happen to be aware, also, of large orders that were and have been held back for months by purchasers determined not to be gouged. Now, however, it would seem that all can buy freely and safely.

Received Energy in Wireless Telegraphy.

The only hope we have of a systematic increase in our knowledge concerning the quantitative actions involved in wireless telegraphy is by extending the range and number of measurements on the properties of wireless-telegraph waves under a number of different conditions. The theory of the subject is as yet only mapped out in rough outlines and much work must be done before it can be expected to be satisfactorily detailed. A contribution to the subject of the interception of energy in wireless telegraphy by Mr. C. A. Culver appears in the September number of the *Physical Review*. A sending antenna 8 meters high was installed about 50 meters away from a receiving antenna at which the energy intercepted was measured.

A number of experimental results are appended to the paper, some of which are in general accordance with results obtained by wireless telegraph tests, and some of which do not appear to be in agreement with results recorded elsewhere. It is to be remembered that although the wave lengths emitted in the case here considered are given as about 500 meters, the distance between the sending and receiving antennas was only about 50 meters, or about one-tenth of one wave-length. This proximity would be capable of introducing actions that might not be found at a distance of many wave-lengths, such as is ordinarily presented in wireless telegraphy. For example, there might be appreciable direct electrostatic influence between the two antennas at so short a distance. It is also understood that in the neighborhood of a sending antenna there are two radiations, one on electromagnetic radiation with its maximum at the earth's surface and with an energy intensity inversely as the square of the distance; the other an electric force with its maximum in the vertical, dwindling with the inverse fourth power of the distance. Consequently, the phenomena produced within the first few wave-lengths of the sending antenna may differ materially in detail from those presented at a considerable distance.

The Fan for Winter Service.

During the coming two months, there is open to central-station companies in all latitudes where hot-air furnaces prevail a method of increasing revenue from residence customers, without any increase in investment by the use of fans for circulating air. In a hot-air furnace the fan is placed in the cold-air intake before the air enters the furnace. Its function is to assist the natural circulation of hot air around the furnace and up the hot-air pipes to the rooms above. Its chief value is in warming up the house quickly in the morning, and in forcing air to rooms on the windward side of a house where the natural circulation is not sufficient to heat the rooms. A fan so used converts many an unsatisfactory heating system into a satisfactory one at a cost which is far more agreeable to the customer than throwing out his hot-air furnace altogether and putting in steam or hot water. The temperature of the furnace-heated house can be brought up much more rapidly with the artificial circulation produced by the fan than when natural circulation is depended upon, with the result that considerable heat which otherwise goes up the chimney during the hot-fire period in the morning is saved. It is interesting to note that tests recently carried on by the U. S. Geological Survey in connection with steam-boiler efficiency, and described in a paper by Messrs. W. T. Ray and Henry Kreisinger, presented before the Western Society of Engineers at Chicago, Sept. 18, indicate a higher boiler efficiency from accelerated fan draft than from natural draft. If the same principle holds true with regard to air passing over the heated shell of a furnace (and it seems likely that this is approximately true) it can be seen why increasing the velocity of air circulating through a furnace can greatly accelerate the rise of temperature in the house. But theory aside, it is now well established that this little plan works well in practice and gives promise of adding considerable to the total revenue of central-station companies the coming winter if it is properly followed up. There is no worthy appliance for household use that receives so enthusiastic a welcome as this when it comes to a house which is chronically hard to heat. The electric fan can also be similarly used in connection with steam heat, by locating it so that it will direct a current of air against a radiator. In this manner the temperature of the air in a cold room may be raised within ten minutes to that of normal warmth.

Direct-Current Power Transmission.

The very striking discussion of the Thury system of power transmission at constant current which we publish elsewhere in our columns will well repay study. We in this country are so wedded to alternating-current working that it is hard to realize the possibilities of anything else, and harder yet to grasp the fact that on the Continent transmissions on the Thury system have approximated the highest voltages and the longest distances commercially undertaken on the three-phase system. A station working at a full-load voltage of 57,600 over more than 100 miles of circuit must assuredly be taken seriously, however far it may depart from standard American practice. The details of operation seem to have been very carefully worked out and the practical working of all these plants seems to be satisfactory. The success of M. Thury in building high-voltage generators has certainly been remarkable, albeit there seems to be a limit of output which it is at present impracticable to surpass. The generators for the Moutiers-Lyons plant are for 75 amperes and 3660 volts each, about 275 kilowatts; and even for somewhat lower voltage 400 or 500 kilowatts seems to represent the upper limit of output. It is possible that the auxiliary-pole construction may facilitate the building of larger machines, yet there seems to be small chance for reaching the sizes now common in alternating-current machines. It is unfortunate that a system otherwise of especial applicability to very long transmissions which for economy should be for great output, should be thus handicapped in capacity of its individual machines. Group-driving of course simplifies the layout of the station, without, however,

helping much in the matter of cost. The inconvenience is not without compensations since the entire raising transformer equipment is done away with, so that the comparison should be between the small direct-current machines and the large three-phase ones with their transformers. Another gain is the relatively simple switching system as compared with the frightfully intricate and costly switchboard equipment common in large alternating stations. We have several times of late commented on this feature of present construction, which increases the total cost of the station by from a third to a half the cost of the generators and sometimes more. Mr. Thury appears to have worked out his problems of regulation in a very workmanlike manner, so that from an operating standpoint there is little to be feared. Regulation takes various forms according to the result desired, being commonly by reducing the generator speeds or cutting out part of the machines or by a combination of these methods. At full load the efficiency of the high-voltage generators is very creditable, say betwen 93 and 94 per cent, approximately the same therefore as that of alternating-current generators with their transformers. The essential difference comes in the fact that the losses in constant-current machines are nearly independent of load, so that at light output the alternating-current system may have the advantage. Of course, so far as the station is concerned, this difficulty can be for the most part avoided, if the load variations are reasonably slow, by cutting out generators.

It is in the line itself that the strongest claims are made in behalf of the constant-current system. It must be admitted at the outset that a direct current is easier to insulate than an alternating current of the same effective voltage. Further, it has been pretty well established experimentally that the difference is greater than would be indicated merely by the extra height of the alternating-current wave-crest. It is not unlikely that a direct-current voltage of 50,000 is not materially harder to insulate than an alternating-current voltage of 25,000; at least recent results point to about this ratio. And this, even, excludes questions of surging and actual resonance which compel a still greater factor of safety on the alternating-current lines. In the article before us, the author works out at some length the economics of direct-current and alternating-current lines, assuming the same maximum voltage between line and earth, leaving out of account abnormal voltages on the alternating-current, three-phase system. The result is a bit startling, showing that with a power factor of 0.8, by means of an unusually low figure the three-phase system requires about three times the weight of copper required for the direct-current systems. At unity power factor the difference would be less, at lower power factors more. And from the standpoint of maintenance there is the further difference that the alternating-current system is under its full insulation strain all the time while the direct-current system reaches it only at full load, under ordinary circumstances but a few hours per day. One of the startling but rather fantastic possibilities of high-voltage direct-current transmission is the use of ground return either regularly or in emergencies. This has, in fact, been proposed for single-phase transmissions, but in this latter case would certainly involve somewhat greater chance of serious interference with other grounded systems.

It is on the matter of distribution that the direct-current transmission gets into difficulties. For a uniformly distributed load its gain over the constant-potential three-phase system in amount of copper required is relatively small, perhaps negligible when distribution in fairly large units is considered, which in alternating-current work are likely to give high power factors through being synchronous or for lighting loads. On the Thury systems power is not infrequently taken off at several points on the line, but the main delivery is *en bloc*. And obviously the receiving machines have the same limitations as to size as in the case of the generating station, which is a very material disadvantage. As regards reliability of service, the Thury plants certainly have not acquired bad reputations. They are free from some of the troublesome characteristics of alternating-current systems, but have difficulties of their own, particularly in the way of insulation of the machines. The oil insulation on the high voltage side of an alternating-current transmission plant is no mean advantage, both as respects general safety and protection against abnormal line voltages. Even in the case of lightning, an oil-insulated transformer is something of a safeguard. In a direct-current station the machines are very much exposed, although by the free use of choke-coils it is possible to reduce the danger very materially. The disturbances classified as lightning probably take all forms from the single mighty wave crest of a direct bolt to oscillation discharges of high frequency in the more common secondary disturbances; and they are bad upon any system whatever, so that perhaps this phase of the question may be laid aside.

The serious way in which the constant-current system has been considered for the Victoria Falls project is evidence that whatever may be the final judgment as to its merits, it certainly cannot be set aside offhand when very long transmissions are under discussion. No alternating transmission has yet been undertaken in which the length of line has been so great as to bring the phenomena of major resonance conspicuously to the front. A line 500 to 1000 miles long will unquestionably bring out some features of alternating-current theory which have heretofore been wholly negligible. Its natural period would be in perilous proximity to the fundamental and low harmonics of the operating frequency. The economical voltage would be so high and the amount of line exposed to trouble so great, that the requisite factor of safety in the insulation would be difficult to maintain. It is for such extreme cases that direct-current transmission must be seriously considered. As a matter of fact, most electrical power transmissions are under conditions very easily met by the three-phase system with simplicity and economy. Voltages of 50,000 to 60,000 and even somewhat higher, are now managed with comparative ease, and give satisfactorily reliable service over long lines. It is when one needs to double these pressures that one reaches a region of unknown and probably troublesome complications. Were it not for the fact that most extremely long transmissions are likely to be those involving also very great amounts of power, the direct-current system would come in for more frequent consideration. A plant of 50,000 kilowatts in 275-kw units, however, looks like anything except a cheap and manageable proposition, particularly when a similar receiving plant is necessary. If by adopting inter-pole construction or other improvements, M. Thury can get, say, a 10,000-volt generator for 100 amperes, he will come somewhere near to a serious competitive basis for large work. He certainly deserves immense credit for building up a system which, despite its apparent eccentricity, has done excellent work.

Regular Wireless Service Between America and Europe.

With larger plant and better apparatus, Mr. Marconi has now resumed the transoceanic wireless service begun two years ago, and the system is now in regular commercial operation between Glace Bay, Nova Scotia, and Clifden, Ireland. On Friday, Oct. 18, no fewer than 14,000 words were transmitted across the Atlantic, and the work is admittedly excellent. Business is being carried on at a notable reduction from cable rates. The London *Economist* estimated recently that the system must transmit 3,000,000 words annually to be a financial success and might be regarded, after all, as equal only to a thirteenth cable under the Atlantic. At the present initial rate, over 5,000,000 words a year are being transmitted, and Mr. Edison informed the writer last week that in his sober judgment, by "hitting it up" Mr. Marconi, within 10 years, ought easily to be able to transmit 1000 words a minute. He stated moreover that in due time dependence on coast stations would not be necessary, but that New York and London could be placed in easy communication. Mr. Edison also ventured the opinion that the courts would, if the question arose, hold Mr. Marconi free from interference as the first man to establish and maintain this great ethereal system of communication between the Old World and the New. He would be protected by both common law and equity. Meantime, Mr. Marconi has been worthily the recipient of a multitude of congratulations directly and indirectly, including those from President Roosevelt, King Edward, Earl Grey, governor of Canada, Sir W. Laurier, Premier Clemenceau, of France, Lord Strathcone, etc.

The engineers of the system state that at present they can readily send 20 words a minute, or 1200 words an hour. Dispatches, as received, are "O. K.'d" back as in cable work. While the cable rates are 25 cents a word, the wireless rates from this side are 15 cents and from Great Britain 13 cents. Press cable rates are usually 10 cents a word, but the wireless rate is 5 cents, plus land tolls, and in Canada 7½ cents. It is understood that further facilities will soon be afforded by putting the Cape Cod plant again in commission with new and more powerful apparatus.

It is natural that a great deal of interest should attach to the effect of this great success of a rival method, on submarine cables and on cable securities. The quotations for cable stocks have been weaker, but in reality not more than the general decline in the market would explain. The opinions of cable and telegraphic experts have been difficult to obtain, as they all consider it too early to form a fair estimate of permanent conditions. The most prominent cable manager on both continents, however, is Mr. George G. Ward, the able vice-president and general manager of the Commercial Cable Company, who gave out the subjoined statement last week: "We would not be understood as minimizing Marconi's achievements, but submarine cables, being more reliable, we do not believe that wireless will ever prove a serious rival to them. As proof of our estimation of the commercial future of the wireless, I might say we have this minute completed a new direct cable from New York to Havana. In other words, cable companies which are free to adopt wireless methods, if they see fit to do so, continue to invest in new cables. Furthermore, while it is expected that the Marconi system will be improved in the course of years, we anticipate that any such advances will have the effect of stimulating telegraph business generally. History will undoubtedly repeat itself in this case, as it has in many other kindred enterprises."

Mr. Marconi and Mr. W. W. Bradfield, chief electrician of the American Marconi Wireless Telegraph Company, are expected in New York next Friday from Glace Bay, the distinguished inventor proposing to return to England as soon as possible and resume work there. It may be well, meantime, to recapitulate briefly the stages of advance that have brought the system to the present point of perfection. On Jan. 23, 1901, Mr. Marconi established wireless communication on his system between St. Catherine's, in the Isle of Wight and the Lizard, in Cornwall, a distance of 183 miles, thus proving the principle of the non-interference of the curvature of the earth, an interference anticipated by many men of learning, and predicted by cable experts.

These results justified Mr. Marconi in recommending the erection of a high-power station, with the object of telegraphing wirelessly across the Atlantic. Such a station was erected at Poldhu, in Cornwall, and on Dec. 12, 1901, the first clear and intelligible signals sent across the Atlantic were received from Poldhu at a temporary station located near the city of St. Johns, in Newfoundland. To commemorate this event, an official complimentary luncheon was given to Mr. Marconi by the then Governor of Newfoundland, Sir Cavendish Boyle. Soon after this, he was given a memorable banquet on his arrival in New York, by the American Institute of Electrical Engineers, at the Waldorf, when Mr. Marconi made his first appearance before an American gathering, and his first statement of his work and aims to an American audience.

This splendid achievement, about which there was a good deal of scepticism at the time, so disturbed the Anglo-American Cable Company that they commenced a suit against Mr. Marconi, and asked for an injunction to prevent his continuing his operations in Newfoundland. In July, August and September of 1902, Mr. Marconi, at the invitation of the Italian Government, made a cruise in the warship *Carlo Alberto*, and during the voyage carried out important tests in wireless telegraphy. During these experiments messages transmitted from Poldhu were received across land and water (1) nearly as far as Kronstadt, in the Gulf of Finland, Russia, a distance of 1400 miles, (2) at Gibraltar across the whole of Spain, over a distance of 1000 miles, and (3) in the Mediterranean, off the coast of Corsica, over a distance of 1000 miles, although the whole of France and part of the Alps intervened between the two stations. Messages in nearly all positions and places visited by the cruiser were received either on Mr. Marconi's receiver, working a tape instrument, or by means of his magnetic receiver. The reports of these tests were signed by Admiral Mirabello, the present head of the Italian Navy.

As a result of the success of these tests, the Italian Minister of Marine, at the request of the King of Italy, issued orders that the *Carlo Alberto* should be placed at Mr. Marconi's disposal for the purpose of assisting him in the establishment of communication between Canada and England. On the 20th October, 1902, the *Carlo Alberto* left Plymouth and sailed for Sydney, Nova Scotia, and messages were received from Poldhu throughout the voyage to Sydney, a distance of 2500 miles. After a few weeks' preliminary work at the station, which had, in pursuance of arrangements made between the Canadian Government and Mr. Marconi, been erected at Glace Bay, Cape Breton, messages were transmitted on Dec. 16, 1902, to the London *Times* by Dr. Parkin, its own special correspondent and other work was done. It was soon decided, however, that for general and sustained work, more powerful and more sensitive apparatus was necessary, and to that end Mr. Marconi has worked with the results now noted.

Entertainment at Atlantic City Convention.

The program arranged by the entertainment committee of the American Street & Interurban Railway Association provided for many and varied receptions, entertainments, divergences from routine work, etc., when business sessions were not pressing, for the delegates and ladies in attendance during the week of the convention.

On Monday evening Miss Kitty Cheatham entertained in the solarium in the Marlborough-Blenheim Hotel. Informal dancing followed. On Tuesday evening the annual reception in honor of the presidents and other officers of the various associations with their ladies was held in the solarium of the Marlborough-Blenheim.

Tea was served for the ladies at the Country Club of Atlantic City on Wednesday afternoon, where golf and tennis were also

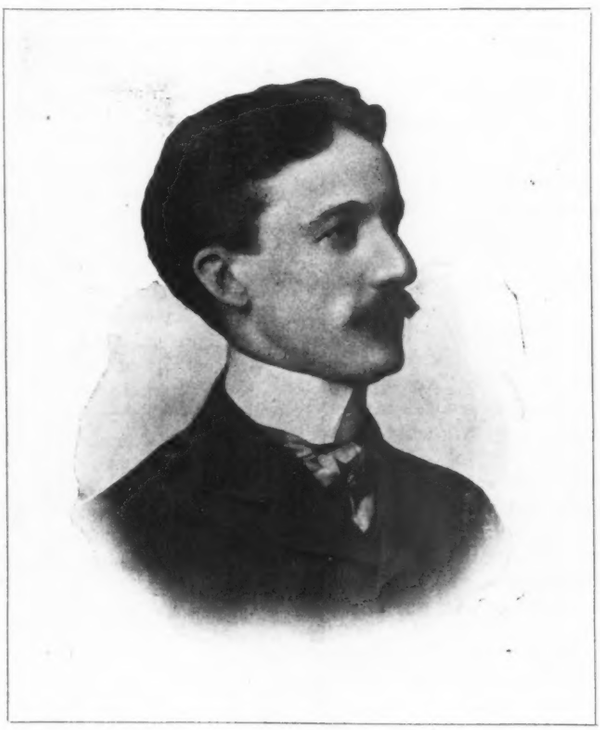
played. In the evening theater parties were held at the Savoy Theater and at Young's Pier Theater. During the day many of the ladies availed themselves of automobile trips.

On Thursday evening the annual supply men's amateur vaudeville performance was given at Young's Pier Theater. The performance was followed by an informal dance at the Marlborough-Blenheim. For Friday evening the entertainment committee provided an informal affair in the solarium of the Marlborough-Blenheim. There was dancing until midnight and between the dance numbers a quartet sang a number of selections. The arrangements made for the use by delegates of roller chairs was greatly appreciated.

American Electrochemical Society Meeting.

The twelfth general meeting of the American Electrochemical Society was held in New York City on Oct. 17 to 19. The programme of the professional papers, as well as that of the excursions and social functions, had been carefully arranged and the attendance was very large. Not less than 284 members and guests registered, which number surpassed the best records of any previous meeting. For most of the preparatory work done to insure success, the president, Prof. Charles F. Burgess, and the secretary of the National Society, Prof. J. W. Richards, as well as the New York section and its indefatigable secretary, Mr. Alois von Isakovics, deserve the cordial thanks of the society.

The Chemists' Club and Columbia University acted as hosts of the society during the professional sessions. The meeting was opened with a reception of members, guests and friends by the president and officers of the society at the Chemists' Club on the evening of Thursday, Oct. 17. A special feature of this occasion were two illustrated lectures.



PROF. C. F. BURGESS, PRESIDENT.

Dr. George F. Kunz, the well-known gem expert, spoke on diamond and moissanite—natural, artificial and meteoric. The lecture was well illustrated by lantern slides, and an interesting exhibit was shown. Mr. E. G. Acheson, of Niagara Falls, lectured on "deflocculated" graphite, or what is the same, colloidal graphite, and its use for lubricating purposes, with demonstrations and experiments. This subject has already been covered in our columns in connection with Mr. Acheson's paper at the Niagara meeting of the American Institute of Electrical Engineers.

For the afternoons, various exceedingly enjoyable excursions had been arranged. On Friday afternoon a visit was paid to the laboratories of Mr. Thomas A. Edison, in Llewellyn Park. Mr. Edison received the party most cordially and the visitors highly enjoyed the pleasure of being presented to Mr. Edison and being shown around the various laboratories. For Saturday afternoon the choice was left between visits to the new Pennsylvania Railroad power plant in Long Island City or to the New York Electrical Testing Laboratories, or to the U. S. Metals Refining Company, at Chrome, N. J. The latter plant, which has recently been much enlarged, is one of the finest examples of modern practice in copper refining. All the various processes of copper smelting, converting and electrolytic copper refining and the subsequent electrolytic parting of the ore bullion into silver and gold were shown to the visitors.

On Friday evening a most enjoyable subscription dinner was held in Liederkranz Hall. The attendance was about 130, among them quite a number of ladies. Dr. Charles F. Chandler was a most jovial toastmaster. A smoker tendered by the Chemists' Club to the society, on Saturday evening, formed the happy conclusion of probably the most successful meeting which the society has ever held.

In the following we give abstracts of the papers presented in the professional sessions, of which the Friday morning session was held at the Chemists' Club and the Saturday morning session in Earle Hall, Columbia University.

ELECTROMETALLURGY OF IRON.

Two papers dealt with the reduction of iron ore in the electric furnace. The first, by Messrs. A. E. Greene and F. S. MacGregor, described experiments made by the authors at the Massachusetts Institute of Technology. They used an experimental furnace of about 60-kw capacity (an illustrated description of which may be found in an article of the same authors in *Electrochemical and Metllurgical Industry*, September, 1907). They used three samples of ore, two of which were iron sands from the Pacific Coast, and the other was a titanium-iron ore from New York State. In tests of the latter the special object looked for was to determine the character of the charge and the temperature limits for which no reduction of titanium takes place. Some figures as to efficiency were given. Details may be found in the article above referred to. The paper was briefly discussed by Dr. Whitney and Dr. Richards.

The second paper on iron reduction in the electric furnace was presented by Dr. J. W. Richards, and was a critical discussion of the well-known experiments made at Sault Ste. Marie with the Heroult furnace under the auspices of the Canadian Government. Dr. Richards reviewed the various runs made. Concerning the manufacture of silicon pig by simultaneous reduction of iron oxide and silica in the electric furnace in the same operation, he thought that this complicates matters and that it is preferable to restrict the operation to iron reduction and introduce as much silicon as desired, afterwards in the form of ferrosilicon.

The chief point brought out by Dr. Richards was that in some of the runs too much carbon had been used in the form of charcoal in the charge. There is in the iron oxide only so and so much oxygen which can combine with the carbon. The less carbon is used, the more CO_2 will be formed. If more carbon is used than is necessary to form CO_2 with the oxygen in the iron oxide, then carbon monoxide will also be formed and the percentage of it will be the higher the greater the amount of carbon in the charge. If even more carbon is used in the charge than is taken care of by the oxygen in the ore in the formation of carbon monoxide, complications will result, since in the elec-

tric furnace there is no oxygen from air to combine with the excess of carbon as in the blast furnace. More ore must then be added. Analyses of the furnace gases (ratio of CO to CO_2) would go a long way to indicate how the furnace is running. Within certain limits the less carbon is used the higher the electrical efficiency of the furnace. Of course, if too little carbon is used, one gets a pig high in sulphur.

SILICON MONOXIDE.

Dr. H. N. Potter presented a very interesting paper on silicon monoxide. Clemens Winkler had formerly tried to get a reaction between silicon and silica (silicon dioxide), but had failed. The reason of this failure, as Dr. Potter showed, was the low range of temperatures within which Winkler had worked. When working between 1700 and 1800 deg. C., Dr. Potter found quite a brisk reaction. But, of course, it is quite possible that the silicon monoxide which is formed dissociates at cooling.

The chief part of Dr. Potter's paper was an account of very elaborate researches offering strong evidence that the author's brown powder "monox" (see abstract of a second paper of the author below) contains silicon monoxide mixed with silicon and silica. The paper was discussed at some length by Messrs. Burgess, Richards, Whitney, Tucker, Hering and Zimmerman.

A paper by Mr. A. B. Albro dealt with the analysis of silicon compounds. He showed that the usual method is not reliable in so far as it does not permit distinguishing sharply between free and combined carbon. Mr. Albro described a new method which overcomes this difficulty and discussed the precautions (for example, the use use of platinum) which must be taken in the analysis of silicon compounds.

BOILING POINTS OF METALS.

A paper by Dr. O. P. Watts was then presented in abstract dealing with the metals in order of their boiling points, as arranged from Moissan's experiments in the distillation of metals and alloys. From Moissan's published results, Dr. Watts has constructed the following series:

Zinc, 940 deg. C.; cadmium, 1025; lead, 1250; silver, 1850; copper, 2100; tin, 2170; manganese, 2200; nickel, 2450; chromium, 2500; iron, 2600; platinum, 2650; titanium, 2700; rhodium, 2750; ruthenium, 2780; gold, 2800; palladium, 2820; iridium, 2850; osmium, 2950; uranium, 3100; molybdenum, 3350; tungsten, 3700.

All the figures represent degrees C. But only the figures for zinc and copper are measured boiling points. The figure for tungsten must be some unknown temperature above the melting point (3200 degrees) and 3700 has been assumed arbitrarily. All other figures are not claimed to stand for the exact boiling points, but only to indicate the relative position of the metal in the series.

Dr. Richards remarked that the volatilization point of a pure metal is different from its volatilization point from an alloy and that this fact must be taken into consideration in the use of the above table, which was determined from experiments with alloys.

CHLORINE IN METALLURGY.

A paper on a new application of chlorine in metallurgy was presented by Mr. C. E. Baker. It dealt with the treatment of sulphide ores. The author argues that in the electrolytic production of chlorine and caustic soda from common salt the caustic soda pays for the process and the chlorine costs nothing. The chlorine gas is supplied to a rotating tube mill containing pulverized dry sulphide ore and acts on the ore, producing the chloride of the metal and sulphur, or at a higher temperature sulphur chloride. The sulphur or sulphur chloride distils off and is condensed outside. In case of lead-zinc sulphide ore, when the chlorination is finished, the contents of the tube mill are supplied to leaching tanks, the soluble chlorides are removed, leaving behind in the gangue with the free gold any insoluble silver or lead chlorides remaining. The gold is recovered from the gangue by cyanidation or wet chlorination or amalgamation in barrels. The solution, after proper purification, contains zinc chloride, which is electrolyzed. The products are zinc and chlorine, which is used over again. The applications of analogous methods to other metallurgical problems was also discussed.

HEAT CONDUCTIVITY OF CARBON.

The comparative heat conductivity of amorphous carbon and graphite was the subject of a paper by Mr. F. A. J. FitzGerald. This is an important matter for the question whether graphite or amorphous carbon electrodes should be used in electric furnace work. Graphite has four times the electric conductivity of amorphous carbon; hence with the same ohmic loss it is possible to double the current density by substituting graphite for amorphous carbon. But if this is done one has to consider that the heat conductivity of graphite is also greater than that of amorphous carbon. This results in increased heat losses. In any case, one has to consider the total effect. Mr. FitzGerald's tests show that graphite conducts the heat 18 times as well as amorphous carbon.

DETERMINATION OF SILICA.

A paper by Mr. W. R. Mott dealt with electrochemical methods for the qualitative and quantitative determination of free silicon in the presence of silica, silicates, oxides, free carbon and carborundum. The author states that a direct process for determining free silicon consists in the treatment of the material to be analyzed with metallic fluorides, such as copper fluoride, silver fluoride, etc. In one step the solid metallic silicon electrochemically replaces the metal in solution, which metal is deposited and may then be weighed, or may be dissolved and determined in any regular way. These methods are direct and are not interfered with by the presence of silica, silicates, metallic oxides, free carbon or carborundum.

GRANULAR CARBON RESISTORS.

The first paper of the Saturday morning session was presented by Prof. S. A. Tucker, with Messrs. A. Doty and R. W. Canchois as joint authors, on the use of granular carbon resistors. Various mixtures of carbons of different grades were tried both with direct and alternating current. While most of the results are given in form of tables, the general conclusions which may be drawn are as follows.

Alternating current seems as suitable as direct current; moreover, a change of frequency with alternating current does not appear to make any essential difference. The more frequently the coke is used as resistor, the smaller appears to be the temperature which is obtainable for the same expenditure of energy. Throughout the experiments it was found that the coarser the grade of coke, the greater its conductivity. Further, any single grade of coke is more efficient than a mixture of all grades.

INDUCTION FURNACE.

A paper by Mr. Gustave Gin on the theory of the induction furnace was read very briefly in abstract, since it consisted almost completely of formulas. In the discussion the necessity of having the primary sufficiently remote from the secondary was dealt with. Mr. Carl Hering said that the effect of the high temperature in the secondary on the insulation of the primary might be overcome by using asbestos-covered wire. But a more serious difficulty is that if the iron core gets heated to a high temperature, its permeability goes down seriously. Dr. E. F. Roeber stated that the well-known formulas of the induction motor would represent a good starting point for the theory of the induction furnace, since both are special cases of the general alternating-current transformer and both have in common the characteristic feature of high leakage.

ELECTROMETALLURGY OF ZINC.

A second paper by Mr. Gustave Gin discussed the use of the induction furnace for zinc metallurgy. He proposes to use the induction furnace, but in a somewhat modified form so as to get efficient circulation. For this purpose the crucible which forms the secondary of the induction furnace is made of a series of channels, the bottoms of which are inclined longitudinally, the deepest part of each being connected by a conduit with the more shallow part of the next channel. This crucible contains a bath of molten iron, on the surface of which is spread a mixture of oxide of zinc and carbon or of zinc sulphide, lime and carbon.

When the proper temperature is reached, the distillation of zinc begins and zinc vapor and oxide of carbon are carried off to the condensing chambers. An estimate of cost is added. The author is convinced that such countries, like Sweden, in which are united in the same regions considerable quantities of complex ores with powerful waterfalls, are well suited for the adoption of electrothermic methods. In the discussion of the paper Messrs. Johnson and Richards criticized some special points in the author's estimate of cost of the process, while Mr. Hering remarked that by his particular construction of the furnace Mr. Gin invites the "pinch phenomenon."

SILVER COULOMETER.

Dr. George A. Hulett and Dr. L. H. Duschat presented a preliminary paper on the silver coulometer. It was an account of an exceedingly careful research giving conclusive proof of the existence of a certain amount of impurities in the silver deposit. In the discussion Mr. Carl Hering suggested using gold instead of platinum as electrode material so as to overcome any troubles which may come from occluded gases.

MONOX.

A second interesting paper presented by Dr. H. N. Potter described the furnace for making monox. It is an electric furnace with an attached chamber for condensing the material.

ELECTROLYTIC THEORY OF THE CORROSION OF IRON.

The last paper was presented at the meeting by Dr. A. S. Cushman on the corrosion of iron as an electrolytic phenomenon. The fundamental idea is that when an iron surface is in contact with moisture (acting as electrolyte), differences in the composition of the iron will result in making some parts of the iron surface anodes and the other parts cathodes. At the anodic spaces the iron will pass into solution, assuming the ferrous ionic state, while hydrogen is evolved at the cathode. The ferrous ions are subsequently oxidized to ferric by the oxygen of the air, resulting in the formation of rust. Dr. Cushman, in cooperation with Dr. Walker, has succeeded in making the anodic and cathodic zones on iron visible in different colors by means of a chemical indicator. Several exceedingly pretty samples were exhibited.

A paper by Mr. H. W. Gillett on the electrolytic separation of silver and copper was read in abstract by Prof. Tucker, while Mr. E. E. Free presented a paper on the electrolytic separation of silver and copper. The papers by Dr. Henry S. Carhart on the theory of concentration cells, Dr. H. E. Patten on electrolytic reduction of nitric acid, Dr. Herman Schlundt on the electroscopic determination of radium, were read by title.

Store Lighting.

The announcement that Mr. Frederick J. Pearson, electrical engineer of Marshall Field & Company, would present a paper on the "Lighting of a Large Retail Store" brought out an attendance of over 70 at the meeting of the Chicago section of the Illuminating Engineering Society, Oct. 10. The experiments which have been carried out on a large scale in Marshall Field & Company's great store in Chicago the past 18 months had aroused the interest of all having to deal with illuminating problems. Mr. Pearson's paper gave in condensed form a large amount of valuable information of practical importance to illuminating engineers. Mr. Pearson stated that two years ago his concern decided to take up the question of changing the entire lighting system in its store. At that time the connected lighting load of the establishment amounted to the equivalent of 32,000 16-cp lamps. Recent additions and enlargements have brought up the connected load to 57,000. Tests of various lighting systems were carried on over a period of 18 months. Mr. Pearson stated that while illumination calculated from the photometric curves of individual lamps, as well as measurements of illumination at the counter level in the actual installations, were made use of in comparing results, he attached far more value to visual tests made by comparing the general appearance of large rooms or sections of rooms lighted in different ways.

There were 25 acres of floor space. To show the multiplicity of requirements, he stated that there were 350 sections in the store, nearly every section having a different class of goods, and therefore presenting somewhat different requirements. It was therefore necessary, if uniformity throughout the store was to be secured, to select a compromise system which would serve fairly well all requirements. The general plan of testing the different illuminating systems offered by the different manufacturers was to take a large room about 150 x 250 ft., equipping one-half with one lighting system and the other half with another. This he thought the best way to bring before the non-technical public and the sales managers the relative effects and efficiencies of the various systems.

Test No. 1 was on four sections, each 22 x 22 ft., containing 1936 sq. ft. Each section had five 125-watt Gem incandescent high-efficiency lamps placed pendant near the ceiling in prismatic bowl reflectors. Walls, pillars and ceilings were white; the store fixtures are of mahogany, and there is dark carpet on the floor of the room devoted to dress goods. Lamps were 11 ft. 8 ins. above the counters. Tests were made at five stations in each panel with three observers, each taking a reading at each station, making 60 observations in all. The watts per square foot were 1.296, and the average foot-candles at stations tested, 3.96.

Test No. 2 was made under the same conditions as Test No. 1, but with two three-glower alternating-current Nernst lamps to each 22 x 22-ft. ceiling panel. The watts per square foot were 1.1 and the average foot-candles at points tested, 3.42.

Test No. 3 was made with lamps 14 ft. 6 ins. above the counters in a room with maple floor and mahogany store fixtures, containing miscellaneous merchandise. The test covered four sections 22 x 22 ft. in which were located 24 test stations at which 72 observations were made. The lamp equipment consisted of five 250-watt Gem lamps for each section, placed near the ceiling pendant in prismatic bowl reflectors. The watts per square foot were 2.56, and the average foot-candles at stations tested, 5.63.

Test No. 4 was made in the same room with the same number of sections as test No. 3 and with the same number of observations and test stations. The equipment consisted of two six-glower alternating-current Nernst lamps for each 22 x 22-ft. section. The lamps were at the ceiling enclosed in sand-blasted globes. The watts per square foot were 2.17, and the average foot candles at stations tested, 5.04.

Test No. 5 was made on the same floor as test Nos. 1 and 2, and included 2288 sq. ft. There were 24 50-watt 16-cp lamps, lamps rated at 3.1 watts per mean horizontal candle, in each panel, grouped in six-light fixtures with the lamps hung at an angle, in 6-in. ground glass shades. Lamps were 7 ft. 2 ins. above the counter level. Sixty observations were taken. The watts per square foot were 2.48, and average foot candles at test stations, 3.11.

Test No. 6 was made on the same number and size of sections and with the same number of observations and location of test stations as test No. 1. The room had dark walls, and contained glassware and china merchandise. Eighty-five-watt tantalum lamps with Holophane reflectors were placed 11 ft. 8 ins. above the counter level, near the ceiling. The watts per square foot were 1.12, and the average foot-candles at test stations, 3.15.

In test No. 7, a 600-watt arc lamp with light-balancing selective diffuser was placed in a section 22 x 22 ft. The lamp was 8 ft. 2 ins. above the counters. The watts per square foot were 1.23, and the average foot-candles at the five test stations, 2.95.

Test No. 8 included five panels 22 x 22 ft. Five Gem lamps were placed on ceiling fixtures with bowl reflectors 11 ft. 8 ins. above the counters. Four of these were 125-watt lamps and one 187 watts. The watts per square foot were 1.42, and average foot candles at test stations, 3.96.

Test No. 9 was made on the same number and size of panels as test No. 8. The room contained chinaware merchandise and

had dark walls. The lamps were 85-watt tantalum, with Holophane reflectors. The watts per square foot were 1.12, and the average foot-candles at stations tested, 3.15.

Test No. 10 was made with two three-glower Nernst lamps to each 22 x 22-ft ceiling panel. These lamps were at the ceiling in 8-in. alabaster globes. The watts per square foot were 1.09, and the average foot candles at stations tested, 3.42.

Mr. Pearson then gave a few figures on life tests of the various lamps. The Nernst lamp on short chain pendants was finally selected for the lighting of the establishment. It was decided that the following average illumination in foot candles was desirable for the various floors: The first floor, 4.5 to 5-ft. candles; all above the first floor, 2.5 to 3; first basement, 3.5 to 4; second and third basements, devoted to packing and shipping, 2.25 to 2.5.

In the discussion, Mr. J. R. Cravath called attention to the probable reasons for the great difference in efficiency of the old low chandelier arrangement as compared with the ceiling arrangements tested. While part of the difference was due to the higher efficiency of the Nernst, Gem and tantalum lamps, much of the saving was due to the fact that with the ceiling lamps, reflectors were used which delivered a large percentage of the total light on the counter level. If proper reflectors were used to deliver most of the light down on the working plant, the height of the lamp had little influence on the efficiency in a large installation.

Mr. Albert Scheible inquired whether the blackening of the reflecting surface above the Nernst glower had been considered in connection with these tests. Mr. Pearson said that all tests were made after lamps had been used 200 hours.

Mr. W. R. Bonham asked as to the different lamps mentioned in the paper. Mr. Pearson stated that the selection of the Nernst lamp was made because of low maintenance cost and because of the color and good general effect of the Nernst lamp as indicated by the preference of the management and the various section managers in the store.

Mr. G. H. Stickney advocated the arc lamp for lighting such stores because of its high efficiency and approach to daylight color values. Mr. Pearson replied that the arc lamp was not seriously considered in this case for the reason that out of the 350 section managers in the store not ten of them would say that the arc lamp was what they wanted to sell goods under.

Mr. George C. Keech called attention to the fact that inasmuch as the test stations were not located at regular intervals throughout the area tested, the average foot-candle values given were not the true average illumination in the section under consideration.

Mr. Stickney said that he had conducted many tests on illumination in stores of this kind and had frequently adopted the plan of measuring the illumination on a line of counters across the room.

Mr. G. W. Barlow asked why the tungsten cluster of four lamps in series would not have been better than Nernst lamps. Mr. Pearson replied that between now and the time when it seemed likely that tungsten lamps would be available in large quantities, the saving over the old system of lighting would pay for several installations.

Fixture Designing.

The October meeting of the New York section of the Illuminating Engineering Society was held on Monday, the 12th, at which time a paper having the title "Fixture Design from the Standpoint of the Illuminating Engineer," by Messrs. V. R. Lansingh and C. W. Heck was read and discussed. The paper pointed out some methods of obtaining satisfactory illumination, without in any way sacrificing the artistic requirements. The authors attempted to show that the requirements of illumination and artistic effect are not incompatible. By means of numerous illustrations taken from dealers' catalogues, Government specifications, books on illumination and original sketches, the authors pointed out certain general principles of design which should be carried out.

Mr. Bassett Jones, Jr., opened the discussion upon the paper by commenting upon the authors' designation of certain fixtures as artistic and others as inartistic, pointing out that a fixture which with certain environments might qualify as artistic in design and workmanship, under other conditions might prove very inartistic. In the design of the fixtures used to illustrate the paper there is much to be criticized in the way of inappropriate structural lines, failure to carry out consistently the original motif in the design and the use of supports of unsuitable size and weight which would offend the trained eye of an architect.

Mr. Beauchelle, referring to Mr. Lansingh's statement that statistics showed 34 per cent of the Vermont school children to have defective eyesight, attributed much of the difficulty to the high intrinsic brilliancy and unsuitable color values of modern gas and electric illuminants.

Mr. Wahle endeavored to defend much of the unsatisfactory fixture design, citing instances where cost limitations practically prohibited artistic design. The fixture man was seldom consulted until all matters of cost and location of lamps had been decided. Improvement in design means usually increased cost, which renders abortive the fixture designer's efforts to secure artistic effects.

Mr. A. J. Marshall referred to the recent change in the attitude of many architects who now manifest a disposition to welcome conferences with illuminating engineers regarding lighting installations.

Mr. E. Y. Porter concurred in the previously expressed opinion that high intrinsic brilliancy of modern electric illuminants is responsible for much defective eyesight. The necessity for concealing or modifying such illuminants cannot be too highly emphasized.

Mr. P. S. Miller observed that while the trend of modern incandescent electric lamps is toward higher intrinsic brilliancy and higher light intensity toward the violet end of the spectrum, the tendency is reversed in the development of modern types of electric arc lamps. The authors of the evening had made an unfortunate choice of a title, because their paper dealt almost entirely with the value of reflectors as adjuncts to other glassware on ceiling fixtures. Considering the paper as a discussion of fixture equipments, it was suggested that improved effects might be obtained by the substitution of opaque for prismatic glass reflectors in ceiling fixtures.

Mr. Lansingh, in closing the discussion, concurred in the opinion that an inappropriate title had been selected for the paper of the evening. He questioned the choice of opaque rather than glass reflectors because the former are often not available in desired forms and sizes, and because they are liable to change and deteriorate after a time.

American Street & Interurban Railway Association Officers.

At the convention of the American Street & Interurban Railway Association and its allied organizations held at Atlantic City, N. J., last week, the following officers were elected:

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

President, C. G. Goodrich, Minneapolis; vice-presidents, Messrs. James F. Shaw, Boston; Arthur W. Brady, Anderson, Ind., and Thomas N. McCarter, Newark, N. J. Prof. B. V. Swenson, 33 West Thirty-Ninth Street, New York, is secretary of the parent organization.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

President, Mr. F. G. Simmons, Milwaukee; vice-presidents, Messrs. Paul Winsor, Boston; F. H. Lincoln, Philadelphia, and W. H. Evans, Buffalo; secretary and treasurer, Mr. J. W. Corning, Boston.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION.

President, Mr. F. R. Henry, St. Louis; vice-presidents, Messrs. R. N. Wallis, Fitchburg, Mass.; W. H. Forse, Jr.,

Anderson, Ind., and S. C. Rogers, New Castle, Pa.; secretary and treasurer, Mr. E. M. White, Birmingham, Ala.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION.

President, Mr. H. R. Goshorn, Philadelphia; vice-presidents, Messrs. A. J. Farrell, Buffalo; W. F. Weh, Cleveland, and J. S.

C. G. GOODRICH, PRES. AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION.

Harrison, Jacksonville; secretary and treasurer, Mr. B. B. Davis, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION.

The officers of this association are elected by the executive committee, which consists of Messrs. W. H. Heulings, Jr., Philadelphia; A. S. Partridge, St. Louis; E. M. Williams, Cleveland; H. F. Martin, Philadelphia; Otis Cutler, New York; James H. McGraw, New York; Frank C. Randall, New York; J. R. Ellicott, New York; Henry C. Evans, New York; K. D. Hequembourg, Syracuse; C. K. Knickerbocker, Chicago; C. C. Peirce, Boston; A. H. Sisson, St. Louis, and H. H. Wilson, Chicago.

CURRENT NEWS AND NOTES.

OUR JAPANESE FRIENDS.—U. S. Consul-General H. B. Miller, of Yokohama, says: "Much of the trade coming to the United States in electrical appliances can be traced to Japanese, who have had training in that line in America."

NEW YORK ELECTRICAL SOCIETY.—The next meeting of the New York Electrical Society will be held at Columbia University, Wednesday, Oct. 30. Mr. E. G. Acheson will give a lecture entitled "A New Departure in Lubrication."

A NEW SUBWAY.—The Public Service Commission now proposes that instead of giving out a contract, New York City itself shall build the new subway for Third Avenue, and possibly operate it when constructed. It will connect with the Brooklyn subway.

EARLY ENCLOSED ARC LAMP.—The *Sibley Journal of Engineering* for October contains an interesting account by Mr. L. B. Marks of his early work on the enclosed arc lamp. The various difficulties he had to overcome to produce a commercial lamp are detailed. The result of Mr. Marks' investigations showed that the solution lay in a long arc of abnormal voltage with a suitably restricted and regulated air inlet to the enclosing globe.

CLOCK FOR ALL PARIS.—A special cable dispatch from Paris, of Oct. 19, says: "The Eiffel Tower now tells the time to Parisians and suburbanites for miles around. Far up on the tower this week was installed a set of electric numerals which change every minute. These are visible at night far beyond the city limits, and record the official time of Paris in order to obviate the old complaint that no two public clocks agree."

PRIVILEGED TELEGRAMS.—The U. S. War Department has passed upon an important point regarding the right of a civil court to call upon military telegraphers for copies of messages which figure in lawsuits. The decision is that when properly subpœnaed the operator may produce private telegrams in court, but that in the case of Government messages he must report the call to higher authorities before responding.

A HEAVY DEATH ROLL.—The New York City Public Service Commission has compiled a table of accidents taking place on the surface, elevated and subway lines of the city for the month of September, as made up from the reports which, under the new law, all companies operating under its jurisdiction, are obliged to submit. Fifty-six persons were killed and 208 seriously injured. Of casualties of all kinds there appear to have been no fewer than 4906, but this was smaller than in August.

WIRELESS TELEPHONY.—Advices from Washington state that the wireless telephones which have been on trial on the battleships *Virginia* and *Louisiana,* of the Atlantic fleet, for several weeks have been given formal indorsement of the Navy Department by the purchase of 27 sets of instruments. The cost of this equipment, outside of the expense of its installation, will be more than $35,000. Extension of the wireless system has also been authorized in an order issued for its installation on the supply ships *Glacier* and *Culgoa,* which will accompany the Pacific fleet, and on the *Panther,* now being fitted out at the New York Navy Yard as a repair ship. The wireless installation will also extend to the supply ship *Celtic,* now being overhauled at the Boston Navy Yard, although the *Celtic* is not expected to accompany the fleet. Wireless has also been ordered installed on the *Arethusa,* the supply ship now fitting out at Norfolk to accompany the flotilla of torpedo boat destroyers to the Pacific coast. The apparatus will be supplied by the Radio Telephone Company, being built under patents granted to Dr. Lee De Forest.

NATURAL RESOURCES.—In a speech at Memphis, Tenn., on his recent Mississippi River trip, President Roosevelt laid great emphasis on the preservation of natural resources, and said: "I have asked the Waterways Commission to take account of the orderly development and conservation, not alone of the waters, but also of the soil, the forests, the mines, and all the other natural resources of our country. Coal mines, oil and gas fields, and iron mines in important numbers are already worked out. The coal and oil measures which remain are passing rapidly, or have actually passed, into the possession of great corporations, who acquire ominous power through an unchecked control of these prime necessities of modern life; a control without supervision of any kind. We are consuming our forests three times faster than they are being reproduced. To allow the public lands to be worked by the tenants of rich men for the profit of the landlords, instead of by freeholders for the livelihood of their wives and children, is little less than a crime against our people and our institutions. As I have said elsewhere, the conservation of natural resources is the fundamental problem. Unless we solve that problem it will avail us little to solve all others. As a preliminary step, the Inland Waterways Commission has decided, with my full approval, to call a conference on the conservation of natural resources, including, of course, the streams, to meet in Washington during the coming winter. This conference ought to be among the most important gatherings in our history, for none have had a more vital question to consider."

UNIV. OF ILLINOIS GRADUATE SCHOOL.—The graduate school of the University of Illinois, which has recently been reorganized under Dean David Kinley and given substantial support by the legislature, has now 145 students enrolled, more than three-fourths of whom are doing their work in residences. There are now 27 candidates for the degree of Doctor of Philosophy.

FUTURE OF CANADA.—Mr. J. A. Osborne, a well-known editor, has just returned to Winnipeg after exploring the Hudson and James bays regions. He located several huge mountains of iron ore which abounds in almost inexhaustible quantities to the east of Hudson Bay, and only needs railroad facilities to become one of the richest countries on the American continent. Near these huge iron ore deposits are immense rivers, from which thousands of electrical horse-power can be developed. Copper, silver, nickel, asphaltum, oil, coal, molybdenum and other riches of the soil were discovered by Mr. Osborne in varying quantities. Here and there small particles of gold were found, but not in paying quantities.

THE STRIKE THAT FAILED.—The recent strike of commercial telegraphers is ending rapidly, and more and more men are going back to work if they can secure it. Every day sees a number seeking reinstatement. The New York City superintendents of the Western Union Company have all been notified that the bonus paid to all its present employes in this city would cease on Saturday, Oct. 18, but the present system of double pay for overtime will continue until further notice. Sunday work will be on a basis of seven hours for a day's work; all Sunday work after regular tour of duty will be paid for at double the hourly rate. Last week, the Postal system withdrew its "subject to delay" notice from all offices and messages. The Western Union intends to increase the salaries if its loyal operators.

DISPUTE AT CHESTER.—The selectmen of Chester have asked the Board of Gas and Electric Light Commissioners in Massachusetts to hold a public hearing in the town on the question of the local central station rates. The plant is owned by Mr. E. Leroy Gardiner. A committee of citizens requested this action in the hope of securing lower rates than those obtaining. A public hearing will shortly be assigned in the town, and the arguments for and against changes in rates will be considered by the board. It has been stated that a new plant will be installed by the fire district in the event of an unsatisfactory adjustment of the problem, but as the town rather than the fire district has the necessary authority to petition the commission, it is unlikely that matters will take this turn. A more probable solution would be the purchase of the existing plant, but the hearing will determine the resulting situation.

AUTOMATIC LONG-DISTANCE TELEPHONY.—Some interesting experiments are now being tried by Manager Johnston, of the Citizens' Telephone Company, Columbus, Ohio, in handling long-distance messages through the automatic exchange. A line has been arranged between Columbus and Dayton, which also has an automatic exchange, and it has been found that an operator in Columbus is able to call any subscriber in Dayton without difficulty. This result had already been accomplished in the case of very short lines with apparent success, but as far as known no experiments have been made at as great a distance as this. If it is found that operating directly through the exchanges is practicable, a great saving of time and trouble will be made, as the work of calling a subscriber to an automatic exchange on long-distance lines will be little more than calling on local lines, and there will be no delay at the other end, unless the line called should be busy, in which case the fact will be indicated to the caller.

HOMES FOR THE MILLION.—During the visit of the American Electrochemical Society to his laboratory at Orange, N. J., on Oct. 18, Mr. Edison showed practical designs and models for cheap cement houses for the million, to take the place of wood and brick. His inventions in this line, he said, will make it possible for a three-story dwelling to be built in 12 hours of actual labor at a cost not to exceed $1,000. Models have been prepared from designs by prominent architects, and during next summer, the inventor said, he will build the first of these ideal homes. "The house of the future is to be made of concrete, in cast-iron moulds that will be formed in sections and fitted together so they can readily be removed as soon as the concrete has hardened," he stated. "These moulds, for a three story house, such as I shall build first, will cost $30,000, but an infinite number of houses can be made from one set of moulds. When the house is finished, the bathtubs, stairs and everything of that sort will be in it, all integral parts of the building. The only wood necessary will be the doors and window sashes. I own the largest cement factory in the world, and of course am interested in promoting the sale of cement. I shall permit the use of my invention, however, to any contractor who will undertake to mix his concrete according to my formula, whether he uses Edison cement or not. I have found that a concrete made of one part of cement, three of sand and five of crushed stone gives perfect results, and I believe the workingmen of the future will be housed in dwellings constructed of that material."

SENT A REAL CALF.—The following story is told as authentic of a recent electrical incident: A young man employed as a construction superintendent by one of the large Bell companies operating in the south, received as his first assignment, the job of restoring service in Mobile, in a certain section of the city where cable would be required immediately for temporary repairs. The company had none in stock and the railroad officials would not promise delivery from Chicago inside of three weeks. The young man, after some study, telephoned his order to the Western Electric Company and instructed the salesman to go to the stock yards and purchase a calf. It was some time before the idea penetrated the cranium of the W. E. representative, but when it did, he tumbled hard. Three days later, a large reel of cable, with a calf tied to it, arrived at Mobile, addressed to the telephone company, bearing a large placard, "Livestock!—Please Rush!". This is the best use ever made of watered stock in the electrical field.

POSTAL TELEGRAPH EMPLOYES.—Mr. Clarence H. Mackey, president of the Mackey Companies, has made the following important announcement: "The Postal Telegraph-Cable Company, appreciative of the loyal spirit displayed by the employes who remained faithful and by those who came to its aid when so many old employes abandoned their duties, believes that this loyal spirit may be strengthened by association into a powerful agency for maintaining good relations between the company and its employes, and the prevention of such movements as culminated in the occurrences of last August, and it has, therefore, in conjunction with its employes, decided to form an association of those employes who have a faith in the disposition of the company to deal equitably with them, who are opposed to strikes, commotions or coercive measures, and who recognize the plain truth that their own prosperity is bound up in the prosperity of the company. Such an association will be called the Postal Telegraph Employes' Association, and its object will be to secure to the company a loyal working force and to its members employment undisturbed by factions seeking to coerce or embarrass or harass the company or its employes; and its further object will be to render financial aid to its employes when sick or disabled, and also in case of death. The directions in which such an association may extend its activities for the benefit of its members may easily be seen. The company contemplates that this association may be made the means of remedying local complaints by affording a ready means by which such complaints may be properly considered, and also, that it may be turned to the purposes of self-help and the advancement of its members, socially, educationally and materially —all of which objects will have the support of the company."

The Supply of Electrical Energy for Industrial Purposes by the Manchester Corporation.

UP to within the past six years, Manchester, England, was considered a bulwark for multi-wire direct-current distribution. Since that time, however, the Manchester corporation, with commendable enterprise, has established one of the largest municipal alternating-current stations in the United Kingdom, and is now supplying polyphase currents for motors direct to consumers' premises. The Stuart Street station of the corporation was primarily designed to furnish a large number of sub-stations with three-phase currents which are converted and distributed as direct current for railway, lamp and motor circuits. During the past year or two, a large number of consumers of electrical energy has been supplied directly from the three-phase mains through step-down transformers.

At present the Stuart Street station contains low-speed vertical engines and flywheel alternators with an aggregate rating of 27,000 horse-power. In addition, a 6000-kw turbo-generator is nearing completion and will shortly be connected to the lines. Approximately 10,000 horse-power is required by the motors connected to the corporation's lines, the remaining portion being used on railway and lighting circuits. Thirty-two high-tension feeders are run from the generating station at present, and it is interesting to note the methods adopted for supplying energy to consumers with a view to economy of main feeders.

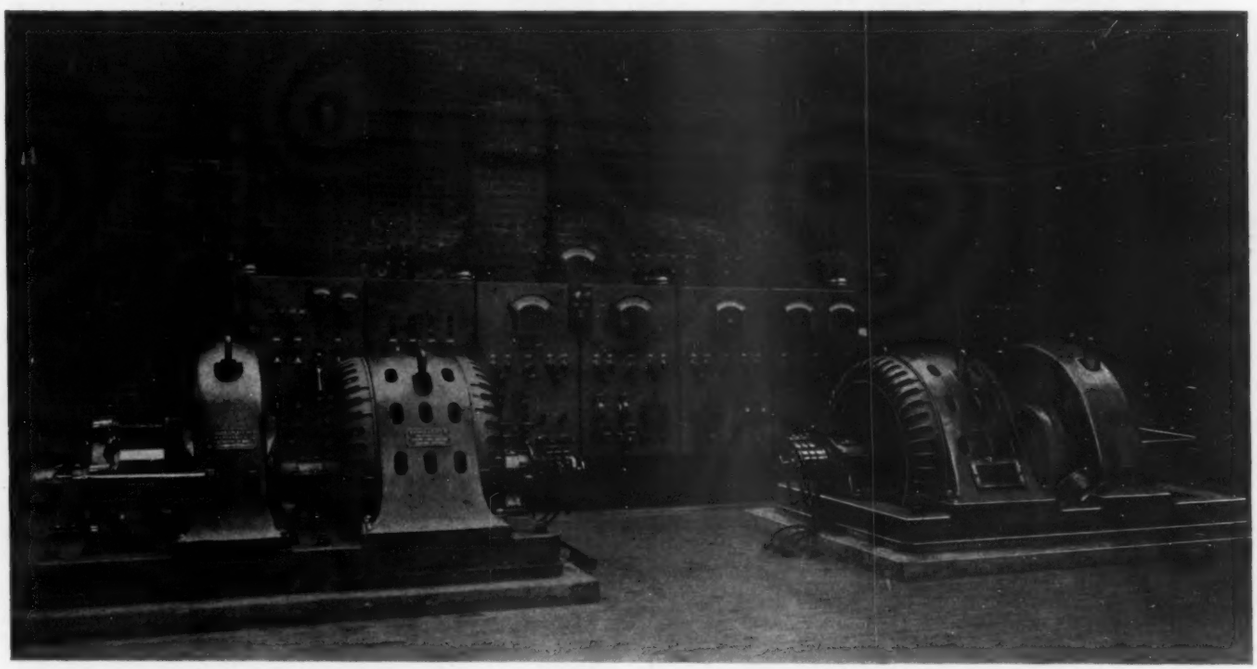


FIG 1.—INTERIOR OF SUB-STATION AT WORKS OF MATHER & PLATT.

Where consumers are on the route of the high-tension feeder lines from Stuart Street to the sub-stations, one cable is looped into the consumer's sub-station. Duplicate cables for lighting and traction circuits are always run between the main stations and sub-stations to separate sets of bus-bars for each section. Selector switches at the sub-station connect either cable to either traction or lighting bus-bars, the buses being also fitted with coupling switches so that a number of changes may be made in the supply of energy to the customer through the looped feeder. The supply is therefore well safe-guarded against interruption.

The consumers' sub-station equipment in the case of new installations is supplied with polyphase currents exclusively. Where direct-curent private plants have been supplemented and the motors are too numerous to replace with alternating-current motors, provision is made for converting the alternating to direct current. The ultimate capacity of the installation determines approximately the size of the sub-station. An interior view of a typical sub-station for alternating-current supply exclusively is shown in Fig. 4. The building contains high-tension and low-tension switch-gear, together with groups of transformers. The high-tension switch-gear and transformers are separated from the low-tension board by an iron grating. The high-tension connections are carefully shielded, and the bus-bars are placed out of reach at the top of the panels. The feeder panels, of which there are two, one incoming and one outgoing, are fitted with three-pole oil-break switches, ammeters, and voltmeters. Each switch has a lock-on-and-off bolt, the switch handle projecting through a slot in the panel. The supply for the feeders is carried through bus-bars to the transformer panels, on each of which are mounted three double-pole, oil, circuit-breakers for controlling the circuits to the three transformers, forming a complete three-phase unit. Each circuit-breaker has an overload relay and a time-limit device, and the tripping coils are mounted below the operating handles. The handle in each case is free of the switch release so that a circuit-breaker cannot be held closed on an overload or short circuit.

The transformers used are of the air-cooled, radiating, single-phase type. One of these having a rating of 200 kilowatts is shown in Fig. 2. This is 3 ft. 4 ins. high, 3 ft. in diameter, and has an extreme height over the high-tension terminals of 4 ft. 2 ins. The transformers make very compact units and being free from oil insulation require little or no attention. Each transformer is mounted on four wheels so as to facilitate transportation, and also to keep the case clear of the ground. The windings are not exposed at any point, and the high-tension terminals on the top are recessed deeply in porcelain hoods. A porcelain cap is cemented on as a cover to the incoming high-tension cable terminal so that there are no loose insulating parts to be dropped or incautiously removed. The high-tension cables are taken underground in trenches in the floor from the transformers to the switchboard outside the high-tension enclosure. The sub-station illustrated contains apparatus having a rated capacity of approximately 2400 kilowatts. The floor area is approximately 900 sq. ft., or 0.3 sq ft. per horse-power installed.

The low-tension switchboard is located in a narrow portion of the sub-station, outside the high-tension enclosure. The cables from the transformer secondaries supply the low-tension bus-bars through a triple-pole switch and three ammeters; the

distributing feeders leave the board by way of three-pole switches and fuses. The transformers are connected up in delta on both the high-tension and low-tension sides, so that three-phase currents may be supplied from any two transformers of one set, should one break down.

When direct current is to be supplied from the polyphase mains, some form of converter is used. The interior of a

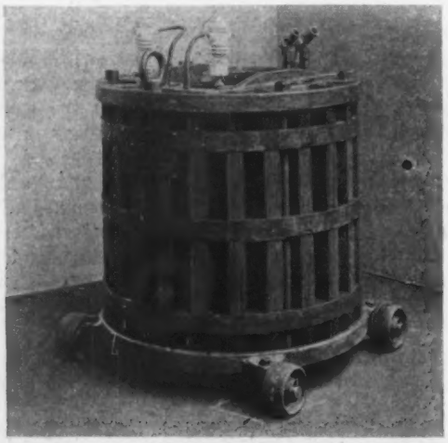


FIG. 2.—200-KW BERRY SINGLE-PHASE TRANSFORMER.

typical sub-station for supplying direct current is shown in Fig. 3. The building in this case was specially erected and contains three motor-converters rated at 500 kilowatts each, together with the necessary switch gear. The floor area is approximately 870 sq. ft., and assuming the capacity of the sub-station at 2000 horse-power, this requires about 1.2 sq. ft. per

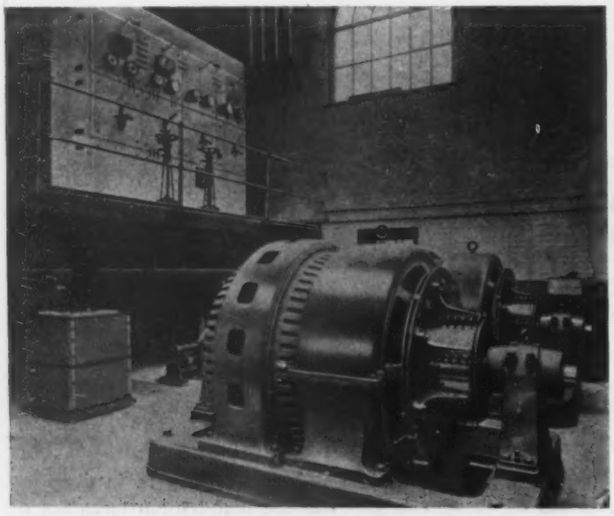


FIG. 3.—INTERIOR OF SUB-STATION AT WORKS OF ARMSTRONG, WHITWORTH & CO.

horse-power. The motor-converters are bolted to concrete foundations, the center of which is recessed for air circulation to the windings and for the cable connections. Trenches are cut into these recesses at each end of the machine, and in these are placed the low-tension cables and the high-tension cables running from their respective switchboards.

The use of motor-converters dispenses with the necessity of step-down transformers, as the transmission voltage can be applied directly to the stator of the motor. Where space is valuable, this tends to economize it considerably. The converters in this particular case are run in parallel with a large private plant. The resistors for the converters are placed under the switchboard gallery facing their respective machines and the synchronizing voltmeter is placed on a bracket so situated that the attendant can watch its movements when he short-circuits the alternating-current ends of the rotor windings, with the switch provided for the purpose on the machine. The efficiency of the motor-converter is very high, so that from the standpoint of the consumer the use of such apparatus will be attended with losses much lower, in comparison, than those with a steam or gas-driven installation.

In certain installations, both alternating-current and direct-current supply are needed from the polyphase mains, so that both stationary transformers and converting apparatus are required. In one sub-station of this type, fed from the corporation's mains, the apparatus is placed in one of the bays of an existing engine room containing a number of steam-driven generators now out of commission. The high-tension switchboard is arranged to divide the transformers from the rest of the station at one end, and the motor-converters occupy the other end. There are six transformers with an aggregate rating of 900 kilowatts and two motor-converters with an aggregate rating of 400 kilowatts. The floor area of the station is about 460 sq. ft., so that the space occupied per horse-power is about 0.27 sq. ft., assuming an installation of about 1700 horse-power. In this instance, no provision is made for extensions, and the space referred to does not include the low-tension switchboard, which is placed in another bay of the station. Each of the feeder panels has a hand-operated, oil-switch and the transformers are connected through double-pole, oil, circuit-breakers fitted with overload relays. The tripping coils are supplied with alternating current, since direct current is not always available for these and the other circuit-breakers. The motor-converter panels provide for a single, triple-pole, circuit-breaker on each panel, an ammeter and an overload relay. The cables connecting the high-tension switch-panels and the transformers are placed in trenches, as are also the cables connecting the motor-converter panels and the machines.

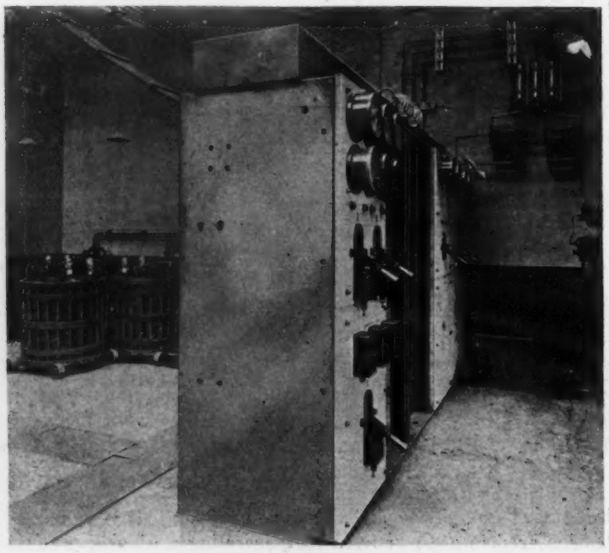


FIG 4.—INTERIOR OF SUB-STATION AT WORKS OF R. JOHNSON & NEPHEW.

The transformers are of the Berry pattern, similar to those shown in Fig. 2.

Not infrequently, it is difficult to find a building in which to accommodate the sub-station equipment so that a separate building must be erected for this purpose. In one sub-station specially erected the area is very much restricted and the floor space per horse-power is 0.6 sq. ft. In this instance, motor-converters occupy a corner of the station and between them is placed the high-tension switch gear. The apparatus installed is rated at 500 kilowatts and consists of two motor-converter units and the necessary switch mechanism for both the high and low-tension circuits. The motor starters and switches are placed adjacent to their respective machines and space is provided behind the high-tension board for access to the connections. This space is enclosed by an expanded metal door kept under lock and key.

In contradistinction to the foregoing example, Fig. 1 illustrates the arrangement of a sub-station where ample room is available. The equipment consists of induction motor-generators for the conversion of the polyphase supply to direct current. The floor area in this station is about 1650 sq. ft., and inasmuch as space is not at a premium, the floor area per

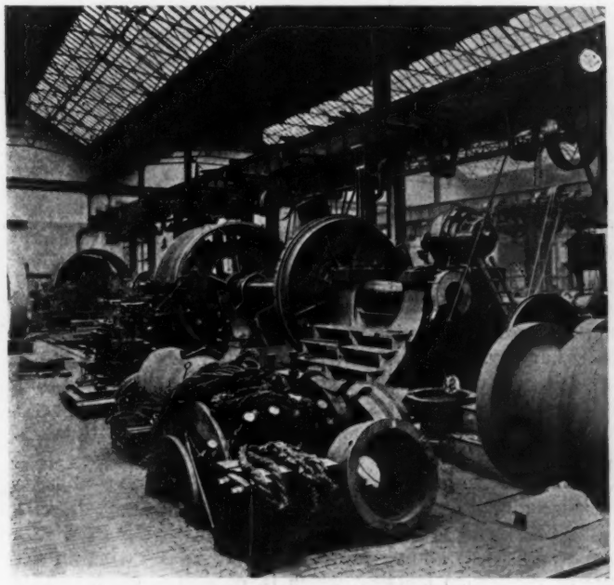


FIG. 5.—LARGE LATHE DRIVEN BY DIRECT-CURRENT MOTOR.

horse-power installed is somewhat high. With a rating of 1080 horse-power, 1.5 sq. ft. per horse-power is the amount of space allotted to the plant and switch gear. Substantial concrete foundations are provided for the motor-generators and an abundance of space is available below the floor level for the cable connections. The switch gear consists of a three-pole, oil, circuit-breaker with a water resistor, the former being mounted on the main switchboard and the latter in a corner.

The agreements made by the Manchester corporation with consumers of electrical energy supplied in the manner indicated, provide that the sub-station building shall be supplied by the consumer. Unless special provision is made, the corporation

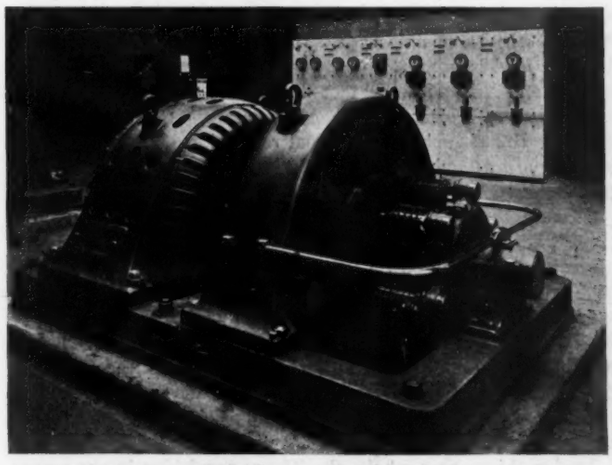


FIG. 6.—MOTOR-CONVERTER.

furnishes the transformers, converters, the high-tension and the low-tension switchboards, and the cable connections between these and the plant. The sub-station building when specially built must comply with the plans of the corporation, and when existing premises are utilized the consumer provides cable trenches, enclosed gratings, doors, etc. The heavier capital outlay is borne by the corporation, and it is understood that the cost per kilowatt installed is approximately $10 with transformers, and $16.20 including expenditure on high-tension mains with motor-converters for installations of 500 kilowatts. The rate per unit of electrical energy is a matter for settlement between the customer and the corporation and depends mainly upon the demand, character and time of the load and special capital expenditure incidental to each supply.

The number of consumers of energy for industrial purposes on the three-phase mains of the Manchester corporation at present is 10, and the total rating of the sub-station plants installed is 7160 kilowatts. Motor-converters make up about 3800

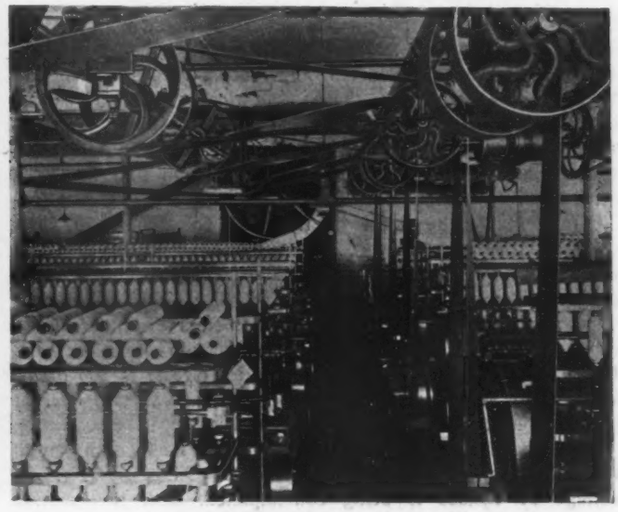


FIG. 7.—SPINNING MILL OF SHAW JARDINO.

kilowatts of this, and transformers the balance. The combined annual consumption of the ten consumers of energy is over 12,000,000 kw-hours

The varied character of the load sustained may be gathered from the industries supplied with electrical energy. Connected to the corporation's lines are two spinning mills, a wire works, a locomotive works, armor-plate works, chain works, electric motor factories, machine tool factories, chemical works, etc. The motors installed in these works range in size from 7½ horse-power to 150 horse-power, the largest induction motor supplied from the mains having the latter rating. Fig. 7 shows a spinning room in a cotton mill which is driven by ropes from a large induction motor. The main driving pulley can be seen in the background against the wall. The motor is supplied from a transformer sub-station in the basement of the mill. In Fig. 5 a large lathe is shown, driven by a direct-current motor supplied

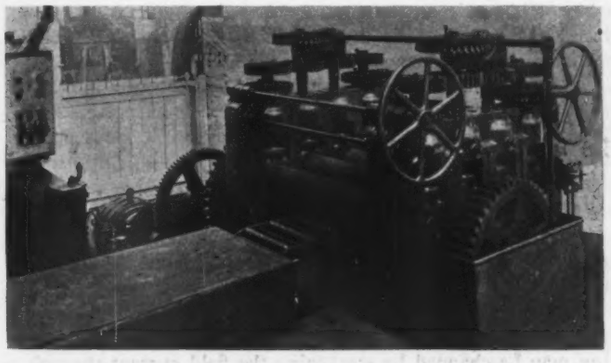


FIG. 8.—THREE-PHASE MOTOR, DIRECT GEARED TO PLATE-STRAIGHTENING MACHINE.

from the motor-converter station shown in Fig. 3. Fig. 8 shows a three-phase slip-ring motor geared to a plate-straightening roll in the Peacock works of Messrs. Beyer. The illustration shows the convenient location of the switchboard and drum-type reversing controller.

It is anticipated that in another year the demand for polyphase electrical energy for industrial purposes will exceed 20,000,000 kw-hours per year.

The Thury Direct-Current Transmission System.

By D. Kos.

THOUGH the Thury power transmission system is generally known,[1] its very special character and the importance of some of its applications in Europe may justify a discussion of its principal features as developed to date and its possibilities.

This system was first practically operated in 1889 in Genoa (Italy), since which time various other transmission plants have been added with constantly increasing voltages. The two best known examples are the St. Maurice-Lausanne (Switzerland) transmission, with 22,000 volts, and the Moutiers-Lyons (France) transmission, with 57,600 volts. In the last mentioned plant there are in the generating station four hydraulic turbine-driven units, each consisting of four generators. The individual generator e. m. f. is 3660 volts, the e. m. f. of the system being 57,600 volts. By grounding one line the voltage can be doubled later on. The transmission line consists of 180 kilometers of copper overhead wire circuit, with conductors of 9 mm diameter and 4 kilometers of underground cable circuit, the cable having a cross-section of 75 sq. mm. Hence, the total resistance of the entire circuit is 100 ohms, and the line drop amounts to 7500 volts, the constant current being 75 amperes. The loss at full load is 13 per cent.

A more ambitious project is to provide Paris with power from the rapids of the Rhone, near the Swiss frontier. A voltage of 140,000 is being contemplated, with the neutral point grounded. Taking equal maximum potential from wire to ground as a basis of comparison, this is the equivalent of 85,000 volts (wire to wire) three-phase, a value slightly exceeding recent practice in this country. As far back as 1901, an experimental direct-current generator was built and used for testing purposes in connection with the St. Maurice-Lausanne plant, which generated 22,000 volts.

REGULATION.

Generating Station.

The distinguishing feature of the Thury system is that the current is kept constant, which is accomplished by motor-operated regulators, cut in or cut out by relay, consisting of electromagnets through which a certain fixed part of the current flows, and which operates as soon as the current varies either way from its normal value. The torque necessary to produce a current in a series generator is proportional to the current and the magnetic flux, which latter again is a function of the current. Thus, considering a prime mover with constant torque under all speeds and no speed regulation, when the current increases through some decrease of the load in the receiving stations, the prime mover must slow down. This will result in a lower e. m. f. of the generator and consequently in a lower value of the current, which will again reach its normal value. When the current decreases the prime mover will speed up, and so restore its original value. Consequently, there exists a tendency toward self-regulation which, of course, must be assisted by a regulating device, operated by the current itself, that will change the speed of all prime movers simultaneously so as to give such an e. m. f. as will produce again the required constant amperage.

Instead of changing the speed, one can also change the flux, the e. m. f. being proportional to the product of the two. The flux may be changed by weakening the field current through a shunt device, or, as was done in the first Thury installation in Genoa, by providing a separate common exciter, the speed of which is controlled by the regulating device. This last solution is the simplest of all, but would be too difficult for real high-tension work, because the exciter circuit must be connected to all of the generators with their very different voltages from ground, which would result in exceedingly expensive insulation of the field coils from the frame.

The e. m. f. could not very well be reduced by means of field weakening below 66 per cent of the maximum value, on account of sparking difficulties, so that further reduction must be accomplished by moving the brushes along the collector, or by cutting part of the generators out of the circuit.

With hydraulic turbines there is no need for these things because the solution involving speed regulation has been worked out in a satisfactory way for this class of prime movers. At lower speed the efficiency decreases considerably, but this is not disadvantageous for hydraulic plants without a storage reservoir.

There is only one regulator for all the turbines, or two in case the central point is grounded, as the loads on the two halves may then differ from each other. The Thury regulator is a complicated piece of machinery, but so are all waterwheel governors; and the fact that only one (or two) must be used, results in a great saving as compared with a plant of many units, where each turbine has its own expensive governor. As the Thury system, moreover, requires very few apparatus, all of which are of surprising simplicity, and thus does away with bus-bar galleries, endless rows of oil switches, numerous switchboard panels with complicated apparatus and wiring, and also with transformers and accessories, the saving should more than balance the greater cost of direct-current generators, with their relatively expensive insulation and greater sub-division, and with several generators for one turbine, as compared with three-phase generation. Moreover, there is a saving in the size of the station building, which is, of course, much smaller in the absence of the things above mentioned.

In the matter of governor economy, it must be understood that only the governor proper is meant, as every turbine requires preferably, though not necessarily, its own servomotor; it is necessary to mention this because one sees frequently, especially in American manufacture, water-wheel governor and servomotor incorporated in a whole. It might also be added that in transmission plants with the central point grounded, one single governor might suffice, provided only one such point is grounded, for instance, in the generating station. The other neutral point must remain without physical connection to earth and will be more or less shifting, according to distribution of load. Furthermore, it is not essential, though desirable, that all generators should have exactly the same voltage, no more than that generators in parallel should all have the same amperage. In either case this means only that the load is not equally distributed among the different machines, and it is this very fact that allows in either system the connection and disconnection of generators to and from the system. But if such an individual regulation is resorted to, the switchboard attendant will have to see that each unit gets its proper share of the load, just as in any parallel system.

In case there is more than one generating station in the circuit, corresponding to the case of several alternating-current systems getting their power from widely distributed power houses, each power station must necessarily have its own regulator, which may be common for all the turbines in that station. A reserve steam plant may be built somewhere on the line, and it is even possible to use the generators as motors if desired. In this case both generator and motor regulating devices must be installed and the regulation must be done by changing the flux and not by changing the speed.

Taking things as a whole, the Thury regulation in the power house compares very favorably with the ordinary alternating system in the case of water power without a storage reservoir. When water power with a storage reservoir is used, conditions are less favorable on account of lower efficiency with lower speed. With steam, probably the same objection will hold, and another design for regulation would have to be made, unless the undesirable method of regulating the e. m. f. by changing the flux were chosen. Moreover, vertical turbines could probably not be used, because one prime mover must be coupled with several generators (unless future designs will allow a greater

[1] See *Electrotechnische Zeitschrift*, 1902, page 1001 (a very complete description); also the same journal, 1906, page 1091. Electrical World, 1906, Vol. 48, page 755. Arnold. "Die Gleichstrommaschine," Vol. II, page 638. *Zeitschrift des Vereines Deutscher Ingenieure*, 1903, page 73.

e. m. f. per generator) and the choice is narrowed down to turbines of the horizontal type.

SUB-STATIONS.

For the motors in the receiving stations, constant speed is in most cases required. There is no tendency toward self-regulation in the motor itself. The torque of a series motor is proportional to the current and the field flux, and hence with a constant current is constant save for variations in the efficiency with different speeds. Consequently, when the motor load is decreased, the motor tends to run away, and when the load is increased, it tends to come to a standstill.

Of course, if the load is a generator supplying a secondary system with energy, an increase of speed would mean an increase of both the secondary e. m. f. and current, and consequently an increase of the motor load, which would speedily create a new condition of equilibrium. A decrease of speed will decrease the motor load in a similar way. At any rate, it may be expected in this case that the secondary voltage will fluctuate heavily. The regulating device for motors is also motor-driven, but its relay is operated by an ordinary centrifugal governor, receiving its speed from the motor-shaft. The only possible method of regulation is to change the field flux, which is mostly done by shunting the field current until the counter e. m. f. is reduced to 66 per cent of its full value, and after that by changing the brush position. It will be seen that the motor cannot be overloaded, even for a short time, which is a serious disadvantage, especially for electric railway work.

The necessity of motor regulation is a great drawback to the Thury system. The writer of this article had occasion, a few years ago, to visit frequently one of the older and smaller Thury plants (in Batoum, Russia)* and was surprised to find the plant running reasonably well with all the regulating apparatus in both generating and receiving station disconnected, the operators not knowing how to repair them. As far as the generating system is concerned, this is not surprising after the theoretical considerations given above, but the motors in the receiving station, driving direct-current generators, which supplied current for a 2 x 110-volt lighting system without a battery in parallel, operated with some hand regulation by the attendant. The secondary voltage was not very constant, but still it was tolerable and by no means worse than what one sees in many small towns. With better operators, the result might have been even better.

In most of the large Thury systems, the secondary systems are three-phase for motor and lamp service, and the regulator seems indispensable. When the motor is used to drive a generator employed for battery charging, the regulator is unnecessary. Probably for any direct-current system with a battery in parallel, the regulator could also be dispensed with. When the direct-current system is used solely for railway purposes, where the voltage need not be so very constant, it might be practicable, in case of an emergency, to operate without the regulating device, even when there is no battery, but the heavy and sudden fluctuations of load which may be expected in this case would make the outcome doubtful.

LINE ECONOMY.

It is intended in what follows to compare three systems, namely: 1. Direct-current series system with neutral point grounded. 2. Direct-current series system with ground return. 3. Three-phase system.

The following symbols will be used:

W = transmitted power in watts

w = loss in watts

$p = \frac{w}{W}$ = relative loss of transmission

I = current per wire in amperes

E = e. m. f. from ground to wire in volts

r = resistance in ohms per foot (one way)

D = length of the transmission line (one way) in feet

r_1 refers to the first system; r_2 to the second, etc.

*This installation has two dynamos, each rated at 100 hp, 50 amp, maximum e.m.f. = 2600 volts; distance of transmission, 7 miles.

The loss in watts of a transmission line of the first type is simply:

$$w = 2I_1^2 r_1 D$$

$$\text{Hence, } r_1 = \frac{w}{2I_1^2 D}; \quad I_1 = \frac{W}{2E_1}$$

$$r_1 = \frac{2pE_1^2}{DW} \qquad (1)$$

For direct-current transmission with ground return, the sum of the loss in wire and ground return is taken as $(1+\alpha)$ $I_2^2 D r_2$. In this case $I_2 = \frac{W}{E_2}$ and

$$r_2 = \frac{pE_2^2}{(1+\alpha)\,DW} \qquad (2)$$

where α is a very small fraction. For instance, experiments with ground return on the St. Maurice-Lausanne plant showed the resistance through ground to be two ohms. This was probably only the constant resistance of the ground plates, and the resistance in their immediate vicinity; by making better connections to earth the resistance was reduced to 0.5 ohm. In such installations as Moutiers-Lyons, where the resistance of the line is 50 ohms (one way) α would be respectively .04 or .01.

These experiments have also shown that, as far as could be ascertained, perfect service is possible in this way and that it does not injure the interests of third parties.

For the three-phase system we have

$$W = 3I_3^2 r_3 D$$

$$r_3 = \frac{W}{3I_3^2 D}; \quad I_3 = \frac{W}{3E_3 \cos\theta}$$

$$r_3 = \frac{3pE_3^2 \cos\theta}{DW} \qquad (3)$$

where E_3 is the potential from the wire to the ground.

The basis for comparison of the three systems is an equal maximum e. m. f. from the wire to the ground,

$$E_1 = E_2 = E_3\sqrt{2}$$

For one wire the copper volume is inversely proportional to the resistance per foot for the same length of transmission D. Bearing in mind that the first system has two wires, and the second only one, we have, calling the total copper volumes V_1 and V_2, the following ratio for transmission of the same power over the same distance with equal loss.

$\frac{V_1}{V_2} = \frac{2r_2}{r_1} \cdot \frac{1}{1+\alpha}$ or nearly $= 1$, which might be expected because the first system is practically a duplication of the second, there being no flow of current through the ground. With three-phase, there are three wires against two with the first system, and

$$\frac{V_1}{V_3} = \frac{2}{3} \times \frac{r_3}{r_1} = \frac{E_3^2 \cos^2\theta}{EE_1^2} = \frac{\cos^2\theta}{2}$$

Hence, in case the three-phase transmission has a power-factor of 0.8, either one of the direct-current systems considered would require only $\frac{.64}{2} = .32$ of the line copper necessary for the three-phase system. Strictly speaking, it would be still a trifle less, because none of the extra losses peculiar to alternating current (skin effect, dielectric hysteresis, etc.) will occur.

The number of insulators required, compared with three-phase, is one-third for direct current with ground return, and two-thirds for direct current without ground return. This makes also the pole construction simpler, especially when, as in accordance with very recent practice, suspended insulators for very high voltages are used, since it is simpler to make a cheap pole construction for two wires than it is for three. Both these

factors mean a great additional superiority in line economy of the Thury system. As there is less liability of excessive voltages caused by surges in a direct-current system, the factor of safety can properly be taken less than that which is customary for alternating-current lines, which would mean cheaper insulators; the usual factor of safety of insulators for high-tension lines being often criticized as being somewhat low, it is perhaps better not to do so, but that would mean again greater safety against insulator trouble, when direct current is used. The line loss of the Thury system is the same in watts for all loads, and, consequently, the loss in per cent is inversely proportional to the load. With an ordinary alternating-current parallel system, the line efficiency is, on the contrary, better instead of worse when the loss is less than full load, the line loss being proportional to $\frac{I^2R}{EI\cos\Theta}$ or to I; in other words, to the load EI, supposing E and Θ to be constant. This is a great argument against the Thury system when steam or water power with storage is used; for water power without storage it does not make any difference.

The foregoing considerations, which tend to show the superiority of the Thury system, apply only to such cases where all the power is transmitted in bulk to the extreme end of the line. When it is intended to distribute the energy over many sub-stations, it will be seen that the advantages disappear to a certain extent. In a series system it does not make any difference whether the power has to be transmitted to the extreme end or part of it to intermediate points, the loss in watts remains always the same I^2R, because all of the current has to go through the entire line. In order to be able to make a comparison with the parallel system, we assume a line which distributes its power equally along its length, *i. e.*, the sub-stations are supposed to be equidistant and of equal size. The volume of copper necessary to transmit the power W over a distance D with a loss of P per cent is

$$V_1 = K\frac{DW}{PE^2}$$

where K is a constant depending upon system and power-factor.

The corresponding volume of copper, when the power is equally distributed along the line, is found as follows: In Fig.

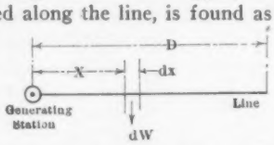


FIG. 1.—DIAGRAM FOR FINDING LINE LOSS WITH UNIFORM DISTRIBUTION.

1 a quantity of power, dW, is to be delivered at dx at a distance of x from the generating station. Having equal distribution, $dW = \frac{dx}{D}W$. If the loss in the line must average P per cent, we must allow at the end of the line $2P$ per cent. As the loss in the beginning of the line will be zero, the average loss will be, for equal distribution and constant density of current along the line, equal to P per cent, and dW will be transmitted with a loss of $\frac{2Px}{D}$ per cent.

The amount of copper necessary to transmit dW is:

$$dV = \frac{K - \frac{Wx}{D}}{2 - \frac{PE^2}{x}} dx = \frac{KWdx}{2PE^2}$$

$$V = \int_0^D dV = \frac{KWD}{2PE^2}$$

Comparing V and V_1 we find that if we make the average loss P in the second case equal to the loss P in the first case

$$V = \tfrac{1}{2}V_1$$

Hence, for approximately equal or uniform distribution of power along a line, only about half the copper is necessary that would be required for transmission of the total power to the end of the line.

For transmission in bulk the ratio of line copper required respectively by the three-phase and the Thury system was found to be $\frac{2}{\cos^2\Theta}$ in favor of the Thury system; for equal distribution it is only $\frac{1}{\cos^2\Theta}$.

The following table gives values for different power-factors. The ratios in the cases considered will be seen to vary from 1 to 4.08 in favor of the Thury system.

Cos Θ	1	.95	.9	.85	.8	.75	.7
Ratio for transmission in bulk	2	2.22	2.47	2.77	3.12	3.55	4.08
Ratio for equal distribution	1	1.11	1.23	1.38	1.56	1.77	2.04

With equal distribution and a high power-factor the advantages of the Thury system in respect of copper economy are very slight. If the greatest part of the power is taken on the first part of the line, three-phase is decidedly superior. The direct-current series system, on the other hand, will give good results when most of the energy is delivered at the farther end. In the European Thury installations, almost invariably nearly all the power is delivered to the extreme end, but small blocks of power are taken off en route. The popular objection to the Thury system that it is only practicable for transmission between a generating station and one receiving station is unwarranted. But it is only desirable to use this system when the sub-stations are more or less concentrated near the end of the line.

A few illustrations out of the many possibilities may be given below. In Figs. 2, 3 and 4, A is supposed to be the generating station and the black dots the sub-stations. In Figs. 2 and 3

FIGS. 2, 3 AND 4.—ASSUMED DISTRIBUTING SCHEMES.

it is supposed that the sub-stations occur only beyond B, and are of such size and location that conditions approximate more or less equal distribution on that part of the line where they occur.

Calling the ratio

$$\frac{\textit{copper volume for alternating current, three-phase}}{\textit{copper volume for direct-current series}} = R$$

we have in Fig. 2

$R_{ab} = 2.77$ for a power-factor of .85 (see Table)

$R_{bc} = 1.38$ for a power-factor of .85.

For the entire line $R = \frac{300 \times 2.77 + 100 \times 1.38}{300 + 100} = 2.42$ for equal total loss in the line.

In Fig. 3 we have again

$R_{ab} = 2.77$ for a power-factor of .85.

On the stretches BC and BD, three-phase would require as much copper as when all the sub-stations occurred on BC, because there are simply two parallel lines of equal power rating and distance.

When using the Thury system, it is clear that when a physical connection is made between C and D, twice as much copper will be required as compared with the case when all these sub-stations occur on the stretch BC. Applying the ratio 1.38 we must allow 100 miles for the Thury system and 50 miles for the three-phase system, to get the comparison correct. This gives the following ratio for the entire line:

$$R = \frac{300 \times 2.77 + 50 \times 1.38}{300 + 100} = 2.25$$

However, it is entirely unnecessary to have a line between *C* and *D* in the special case assumed, because the power was supposed to be evenly divided over the two branches *B C* and *B D*, so that *C* and *D* may be grounded. The current will flow through ground between *C* and *D*, as indicated by a dotted line, with negligible resistance. In that case 50 miles must be allowed for both systems, which gives $R' = 2.57$.

In Fig. 4 the transmission line is a ring. It is supposed again that the sub-stations are such that equal distribution is approximated. By following the same right of way we could build two three-phase lines from *A* to *B* along two different routes (a link between two of the sub-stations may be left out in either system), and the ratio *R* for the entire line would be 1.38 for a power-factor of .85.

But in general, it will be feasible to build a three-phase line in an entirely different way, by using a main line with branches, as indicated by dotted lines, which may give a much better economy, so that *R* might be even less than 1, *i. e.*, in favor of three-phase.

A diagram, giving the potential between the two wires and ground, is shown in Fig. 5 for a direct-current series distribu-

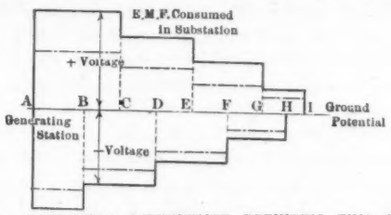


FIG. 5.—POTENTIAL DIFFERENCE BETWEEN TWO WIRES.

tion with neutral points grounded. The line *AI* represents the transmission line; *C, E, G* and *I* are sub-stations on the positive wire; *B, D, F* and *H* are sub-stations on the negative wire. Between *H* and *I* one wire is grounded. The ordinates on either side of the ground potential line give the positive and negative voltages of the respective wires. It will be seen at a glance that only a limited stretch has full voltage between wire and ground. Near the end of the line the voltage is quite low, and between *H* and *I* there is no voltage at all on one of the two wires. The diagram is supposed to be drawn for full load on all stations; if the load of any or all decreases, this can only result in a still lower voltage, as indicated by a dotted line. Consequently, high-voltage insulators are only necessary on part of the line, and various cheaper kinds, designed for lower voltage, can be used on each succeeding section. This illustrates in an indirect way that for wide distribution the full benefits of the Thury system cannot be realized. The line is only a high-tension line at the start, but degenerates into a low-tension line towards the end.

Under such circumstances, the advantages of direct current are more or less neutralized by the use of the series system. A direct-current parallel system would take in all advantages, but as each sub-station would necessarily require a sub-division of the voltage over many motors, it would be hardly practicable, save in the case where there are only one or two large receiving stations. With one receiving station only, it is, of course, identical with the series system.

It might also be possible to regulate the series system on constant voltage instead of constant current. This would bring the system on a par with the ordinary method as regards line efficiency for lower loads than normal. It is, however, immaterial for water power without storage, and the system would lose much of its simplicity. Moreover, none of these alternate schemes has been worked out, and if this would be done, many difficulties in solving the regulation and other problems would have to be overcome. As this has already been achieved for the Thury system, it has at least for the present, commercially speaking, the direct-current field for itself.

CONTINUITY OF SERVICE.

Lightning Troubles.

Quoting from an article on the Thury system in the ELECTRICAL WORLD of Aug. 27, 1907, page 352: "A principal source of trouble with the direct-current transmission system is from lightning on the overhead lines. This is, however, a source of trouble with almost all transmission lines in Switzerland, and there seems to be no reason for supposing that the trouble is increased in the case of a direct-current system."

However, it would seem that a static discharge may be much more destructive when it finds its path through a motor of the Thury system, than when it lands in an oil-filled high-tension transformer. In a grounded station, the discharge finds its way to earth through a series of generators or motors, where it is liable to work much havoc, but in the alternating-current station it would have to work its way through a strong insulation, while the oil will smother any arc which might occur if it succeeded. Consequently, it would seem that much more care should be given to protection of Thury stations than is customary for alternating-current stations. Choke coils can be introduced in a direct-current system without any other loss than that caused by ohmic resistance. The main source of trouble, the line itself, offers the same opportunity to lightning, no matter whether direct current or alternating current is used.

Other Protective Apparatus.

Where the alternating current has its overload relays, reverse-power relays, etc., the Thury system has its overvoltage short-circuiting switch, excess speed short-circuiting switch, and inverse rotation short-circuiting switch. The latter should be more reliable than the reverse-power relay, because it is actuated by direct current and hence there is no possibility of becoming inoperative in case of trouble, because there is no angle of lag which can suddenly jump to nearly 90 deg. Furthermore, there can be no surges on account of resonance and other troublesome alternating-current phenomena.

A more or less prevailing opinion that the Thury system should be less reliable, because all of the current has to go through each individual sub-station and through each individual motor in those sub-stations, is of course not correct. If in a parallel system a sub-station or transformer is troubled by a short circuit, it will have to be disconnected, for instance, by an automatic circuit-breaker, or otherwise the whole transmission system will suffer. In the same way, when the current is interrupted in a Thury sub-station or one of its motors, the automatic short-circuit device must operate to let the current pass by. Supposing the automatic circuit-breaker and the automatic short-circuiter to be of equal reliability, it can hardly make any difference whether all of the voltage or all of the current is admitted in each sub-station, as is respectively the case in the two systems.

Breakdown of a Line.

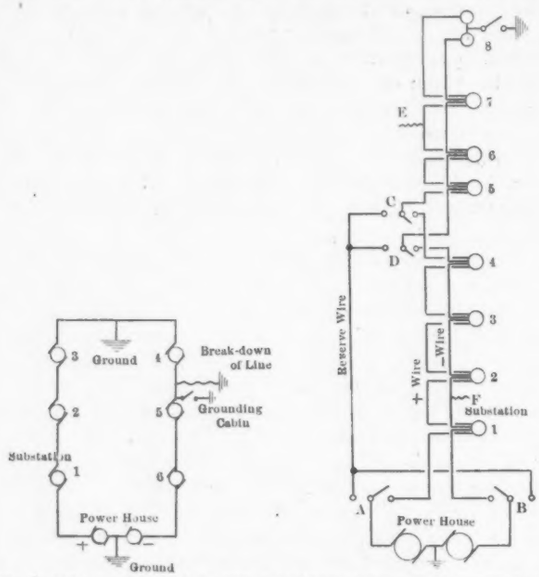
In respect to line breakdown, the three-phase system with grounded neutral has very little that is commendable. If one of its three wires breaks or gets grounded, the entire service is interrupted until repairs can have been made. To be sure, operation with two wires and ground is theoretically possible, but this is seldom attempted and it is of slight practical value. As a rule, where continuity of service is an important factor, a duplicate line is provided. Mr. E. J. Young* proposes for that reason a single-phase transmission with grounded neutral, which for the same voltage between ground and wire obviously has the same line economy as the three-phase system, and by means of a system of double-pole, double-throw switches for every transformer, continuity of service is assured when one of the line wires breaks down. If the two wires were carried on separate poles or structures, continuity of service would be almost certain, as it would take two coincident accidents to cause an interruption.

Such favorable conditions cannot be realized with the Thury system. If only one wire and ground are used, a breakdown will give a complete interruption, at least in that part of the line which is beyond the break. If there are any sub-stations between the power house and the point of trouble, the line should be grounded at the last sub-station on the generating station side of the break, in a grounding cabin, which should be installed in every sub-station. Pending repairs, that first part of the system could continue to give service. Where con-

*Transactions A. I. E. E., May, 1907.

tinuity of service is of great importance, a duplicate line must be installed over the entire stretch, entailing 100 per cent extra line investment. When two wires and a grounded neutral point are used, conditions are better, as only one extra line, or 50 per cent extra line investment, would be required to insure continuity of service.

In the Lyons-Moutiers installation as yet no grounded central point is used, the present plant being considered one-half of the future plant, or at least has been laid out with that possible end in view. At present when one of the two wires breaks



FIGS. 6 AND 7.—SCHEMES FOR TRANSMISSION OVER A WIDE AREA.

down, the return can be made through ground, so that no extra provisions are necessary to insure continuity of service. But at the same time, it is practically equivalent to a 30,000-volt installation and has 60,000-volt insulation.

In the Paris transmission scheme, which involves the grounded central point, it is considered sufficient that one-half of the power supply can be continued if one wire breaks down The two wires will be carried on separate pole lines, to exclude the possibility that the two wires might be disabled at the same time.

In case no transmission in bulk, but transmission over a wide area is involved, Fig. 6 represents the conditions arising after a breakdown, which is supposed to occur between sub-stations 4 and 5 on the negative wire. It will be seen that in this case only sub-station 4 is shut off until repairs are made. It will be necessary to close the switch in the grounding cabin, shown in sub-station 5. If the line were capable of withstanding a higher voltage, the two permanent grounds could be disconnected, a second grounding switch in sub-station 4 (not shown) closed and the whole system could, pending repairs, be operated again, though with excessive voltage on the positive wire.

If the break occurs between the power house and either 1 or 6, the line would be subjected to 100 per cent extra voltage. Hence the first suggestion is of very limited applicability, in general only when the break occurs very near the end of the line.

A second suggestion may prove to be of more general interest, though entailing some additional copper and switching apparatus. It is indicated in Fig. 7. There are in this particular case eight sub-stations, and it is supposed that the first four take together as much power as the last four. Each sub-station, and if desired each of its individual motors, can be switched either on the positive or on the negative wire. The details of this arrangement will be shown later on. Double-throw switches, *A, B, C* and *D*, permit either the positive or the negative current to be conducted to a point just beyond sub-station 4 through the reserve wire, instead of through its regular wire.

Suppose a breakdown occurs at the point *E*, on the positive wire between 6 and 7. The ground in sub-station 8 must now be disconnected and the positive section 6-7 grounded in both sub-stations 7 and 6 (the ground switches are not shown). Consequently, *E* is the new grounded neutral point, and sub-stations 7 and 8 must be connected to the negative wire, while in sub-stations 1, 2, 3, 4, 5 and 6 connections must be made in such a way that four of them run on the positive side and the remaining two on the negative side. It will be seen that when the breakdown occurs beyond sub-station 4 (or, in the case of approximately equal distribution, on the last half of the line) no reserve wire is required. If, however, a break occurs between the power house and sub-station 4, the loads cannot be divided evenly on the two polarities and the reserve wire becomes necessary. If the break takes place, for instance, at *F*, between 1 and 2, on the negative side, the negative current must be made to flow through the reserve wire between the power house and *D*, while sub-stations 1, 2, 3 and 4 must be switched on the positive side, and sub-stations 5, 6, 7 and 8 on the negative side. The ground connection at 8 could remain if this sub-station is of comparatively small size, or otherwise the connection made on its positive side. In this particular case, each of the sub-stations 5, 6 and 7 would require four grounding switches, the sub-station 8 two (not including the one that is shown), while 1, 2, 3 and 4 need not have any grounding devices.

For equal distribution this scheme requires 25 per cent extra copper and insulators. For distribution in bulk, as shown previously, 50 per cent extra is necessary in order to give complete protection against possible shutdowns. As the transmission in bulk requires half as much copper as equal distribution, it is interesting to note that the extra amount of copper necessary in both cases for continuity of service is, therefore, exactly the same, being respectively 50 per cent for one-half, and 25 per cent for one.

The possibility of switching each sub-station or motor on either the positive or negative side gives the additional advantage of always being able to balance the system correctly. On the other hand, savings in insulators (as outlined under line economy) cannot be made. The details of switching at each sub-station are shown in Fig. 8. The switches *G* are grounding switches, only necessary in sub-stations beyond the junction with the reserve wire, as previously explained, and the switches *A* are over-voltage, short-circuiting switches.

Two double-pole, double throw switches are necessary for every motor or group of motors. These two switches must be either mechanically (as shown) or electrically interconnected, so as to operate simultaneously. According to what may be

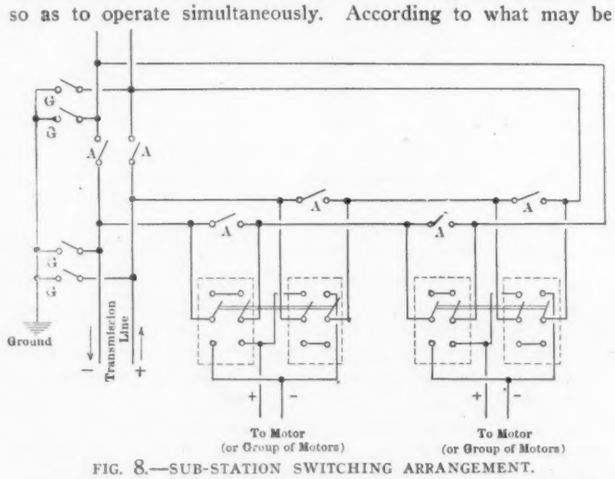


FIG. 8.—SUB-STATION SWITCHING ARRANGEMENT.

desired in each individual case, such a pair of switches may operate the entire sub-station, or again, the sub-station may be divided into several groups—if need be as many as there are motors. Fig. 8 shows a division in two groups.

When a ground occurs somewhere on the line, voltmeters in two of the sub-stations will show by their zero-indication which section is affected. Someone on the system, for instance the power-house operator, must perform the duties of "load despatcher," and as soon as he is informed where the trouble is, must telephone orders to the different sub-station operators.

There is available yet another method which is analogous to the one used in ordinary three-phase practice. In a Thury system with ground return, it is possible to divide the system into two halves, each having its own line to the receiving station. In case of trouble on one of these two lines, the two halves can be connected in multiple, using together the remaining line. Similarly with a Thury system using two wires and a grounded neutral, the switching equipment can be made so as to permit, in case of an emergency, a connection of the generators in the same way as mentioned above, using the intact line only with ground return. For this multiple connection it is necessary to subdivide each turbine-driven unit into two semi-units, one of which is to be connected in one half and the other one in the other half of the system. This feature insures the practicability of operating in parallel two groups consisting of series generators in series. In the receiving station similar arrangements must be made; two motors for one dynamo. It is to be noted that each of the two lines must have sufficient current-carrying capacity for twice its normal current and that the line loss will be doubled, as compared with operation over two wires. It will be seen that this is exactly like the standard practice for three-phase transmission, where two lines are provided, each one being able to transmit the entire power. For distribution to several sub-stations, one of the additional disadvantages is that even the smallest sub-station must have two motors instead of one, in order to make series-parallel connection possible.

Lightning Protection in Colorado.

At the convention of the Colorado Electric Light, Power & Railway Association, at Denver, in September, Mr. Leonard Wilson, engineer of the Denver office of the General Electric Company, gave an address on "Lightning Protection in Colorado," dealing especially with high-tension transmission lines. Mr. Wilson stated that protection against lightning is one of the chief problems to be met in connection with successful high-tension transmission in the state of Colorado, because it is lightning that puts the maximum strain upon line insulators. The Central Colorado Power Company is planning to deliver power at 90,000 volts. Such lines will be successful if the lightning protection is able to keep the maximum voltage down to within 90 per cent above normal. The effect of interrupting a short-circuit is to cause an abnormal rise of voltage on the line, this depending on the natural frequency of the line, which in turn depends on its length. The natural frequency of the line in cycles per second is equal to 47,000 divided by the length of the line in miles. Measurements on lines in Colorado show that frequencies of lightning discharges measured varied between 2000 and 10,000. The low-frequency discharges were measured photographically by the oscillograph, while the high frequencies were measured by tuned coils after methods employed in wireless telegraphy. The arresters in use in Colorado are mostly of the multi-gap type. The connections of the two principal types were shown diagramatically on the blackboard. One has a number of spark gaps in series and with non-inductive resistance in series with the gaps between line and ground. The other has a number of spark gaps in series between line and ground with non-inductive resistances shunted around a part of the gaps in order to assist the initial discharge in jumping gaps. These arresters give good protection for line oscillation, but discharges of high frequency and high energy will jump through insulation from five to ten times that represented by the arresters, rather than go through the arresters.

He then described two types of electrolytic arresters which had been tried in Colorado the past season. The liquid-electrode arrester consists of two terminals supported a short distance above the surface of a jar of electrolyte. One of these jars was used for every 1500 volts line pressure. The discharge passed from the terminal to the electrolyte and from the electrolyte to the other terminal. The action of this arrester is dependent on the air gap between the terminal and the surface of the liquid and on the mechanical action of the liquid, which is borne away from the terminal by the discharge. The other type of arrester tried was the aluminum cell, making use of the well-known action of aluminum electrodes in opposing the discharge of current in a certain direction. These aluminum arresters were made for 300 volts per cell. He seemed very confident that either of these liquid arresters would take care of any discharge, and that they will be introduced for lightning protection in Colorado. In the east, he said, little difficulty was experienced with lightning protection on low-voltage circuits, but in Colorado there was considerable. He cited a lot of 500-volt arresters which on test would not discharge on a pressure of less than 20,000 volts. He thought the solution of the difficulty in this case was also the aluminum cell.

Mr. Clark, of Victor, said that on the Pueblo & Suburban Company's 20,000-volt line, both the liquid-electrode and the aluminum-cell arresters had been tried the past season, but that the season had been a very mild one for lightning. Mr. E. P. Dillon said that at Colorado Springs there had been no bad storms this year. Combination shunted-resistance and multi-gap arresters had worked well. He asked as to the drying out of the aluminum cell. Mr. Wilson replied that the aluminum cell was sealed in a case to prevent drying out. It would probably need overhauling once a year to renew the plates. Mr. Wallace, manager of the Canon City to Cripple Creek transmission line, said that his company, after much trouble with lightning, had put in two sets of arresters—one inside the power station and one outside. In the last three years practically no damage had been done by lightning. This season there had been 20 or 25 storms. Previous seasons there would be one along the line nearly every afternoon. Mr. Corbett, of Georgetown, said he had taken down the overhead ground wires from his company's lines because of their inclination to get tangled up with the transmission line. Mr. Clark, of Leadville, reported operating a 6600-volt line at an altitude of 10,000 ft. Most of his lightning trouble was with meters on the secondary circuits on low portions of the line.

Experience with Gas Engines.

At the recent Atlantic City meeting of the American Street and Interurban Railway Association, Mr. Paul Winsor, chief engineer of motive power and rolling stock of the Boston Elevated Railway Company, read a paper on the experience during the past year with the gas-engine generating plant at the Somerville Park station. This paper supplemented one on a similar subject presented at the meeting last year of the Association.

The Somerville station is equipped with two 600-hp Crossley gas engines supplied by a pair of Loomis-Pettibone gas producers, the engines being direct-connected with 350-hp Crocker-Wheeler generators. The plant was started in May, 1906, and since then there have been no shutdowns, accidents or failures.

Ignition current is supplied by 14-volt generators in connection with floating storage batteries. The igniters originally had platinum tips which were expensive and gave considerable trouble, but during the past four months they have been operated without platinum and with less trouble. The average coal consumption during the period from January to August of this year was 2.034 lbs. per kw-hour, or 1.404 lbs. per brake hp-hour. This showing is larger than that of last year, when 1.45 lbs. per kw-hour was reported. The paper states that the smallness of this figure was due to errors in weighing and checking coal. During the same period of seven months, the coal consumption of the steam plants average 3.477 lbs. per kw-hour, thus showing a superior efficiency of 41.5 per cent for the gas-engine plant.

In conclusion, Mr. Winsor said he believed that a gas-engine plant making its own producer gas will operate at least as reliably as a steam plant and will use from 30 to 60 per cent less fuel, depending somewhat upon the size of the steam plant with which it is compared. The drawbacks of the gas plant are, first, cost, which approximates $200 per kw when rated

so as to have a 33 1/3 per cent overload capacity; and second, the small size of units, the statement being made that the largest gas engine now built is only of 3000 kw capacity.

Technically Trained Men for Electric Railway Service.

Professor H. H. Norris, of the Cornell University, in a paper presented before the Atlantic City meeting of the American Street and Interurban Railway Association, brought out the advantages of the technical graduate to the electric railway industry. "The technical school," he said, "is intended to educate young men in the best sense of the word, and the education which does not make young men better business or professional men is not a satisfactory education. A few years ago there were three classes of employers; one placing too high, the second too low, and the third, a correct estimate upon the value of a technical education. The first class of employers placed too much responsibility upon the young men at first, supposing that they were already engineers. As a consequence many failed to meet the expectations, and gave apparent reason for criticism of their technical training. The second class of employers, not realizing the purpose of technical education, failed to take advantage of it, and did not give the young men suitable opportunity to rise. The third class of employers fortunately realized both the shortcomings and the merits of technically trained young men. Opportunity was given for overcoming the former, and the latter were utilized by placing such responsibilities upon the shoulders of young men as they were able comfortably to carry.

"The manufacturers were the first, and have been foremost in utilizing the product of the technical schools. They have carried this to such an extent that apprentice courses are offered by all of the large companies, and the young men are given every possible opportunity to develop normally and quickly. They are taken through all departments of the works, learning in each enough of the detail to enable them to appreciate the reasons for the development of existing forms of apparatus, and for the employment of present methods of construction. They test the finished product and so learn what to expect of the various classes of machines.

"The operating companies are now taking this matter actively in hand, and a few lighting companies have developed courses similar in purposes, but necessarily different in plan from those of the manufacturers. The Denver Gas and Electric Company was a pioneer in this direction, and their example is being followed by other companies.

"The men who are now controlling the electric railway companies have largely grown up with the industry. The experience of many dates back before the early nineties, when the horse was supplanted by the electric motor. These officials are now training young men to take their places when they retire, and they naturally desire to find for this purpose individuals with the necessary characteristics and training. For many reasons they have the right to expect the technical schools to supply the class of men required. The first of these is, that the technical schools should, and probably do, attract a large proportion of industrious, active and capable students. A young man who has the nerve and ability to conquer the difficulties of a technical training, especially if he is financially handicapped, ought to be one who is needed in business. In the second place, the mental and physical discipline tends to bring out his good qualities and make him self-reliant and original. It increases his initiative power, the most important business qualification which he can possess.

"It is surprising that such a comparatively small number of the technical graduates find their way in the electric railway business. Of the more than two thousand graduates of Sibley College, probably not more than fifty are directly or indirectly engaged in this line. Of these, quite a proportion are in the supply business, and only a small number are actually in the field. This is probably not because railway work is not attractive, but other lines have been so much easier to enter that they have attracted the bulk of the graduates. Some kind of an apprentice course would be welcomed by technical students. They enjoy any work in this direction that is given in the schools, and they show great aptitude for it."

Professor Norris suggested the following arrangement for such a one and one-half year's course:

(1) Three months in Master Mechanic's Department. This time should be largely spent in the car barns and repair shops. The apprentice can serve as helper on car inspections and repairs, construction of special parts, tests, etc.

(2) One month in Purchasing Agent's Department, partly as assistant to the store-keeper, and partly as general assistant to the purchasing agent.

(3) Three months in Motive Power Department. This time should be spent as general helper, oiler or in any other capacity in which the apprentice could be made useful. He could also assist on tests, designs for repairs and inspections. He could also act as emergency supply for sub-station attendance. A short time in the superintendent's office would familiarize him with the details of administration.

(4) Two months in Transportation Department. The apprentice could be given miscellaneous work in connection with the preparation of time tables, familiarizing himself with the train despatching system, and, in general, making himself useful to the superintendent. In many ways he could assist in this department as emergency supply in ticket office, on express cars, etc.

(5) Two months on outside line work. The apprentice could be employed as assistant with the repair gang, and he could also make himself useful in construction of new work, testing, repairs to instruments, etc.

(6) Three months in Way Department. This time should be spent in office work, laying out details of new construction of track, bridges, etc. The apprentice should also assist in surveying and other field work.

(7) Two months in Comptroller's Department. This time should be spent as general office assistant, and in conducting special investigations for the financial officers of the company. A technically trained man would be well equipped by this time to be of great assistance in compiling statistics. These cover not only the operation of the company itself, but of other companies. The appretice would thus become familiar with the methods of accounting used, and of the relation of this department to the others.

(8) Two months in General Manager's Office. The apprentice should now be in a position to be of practical use to the manager, and could be detailed to special duties which happened to demand attention.

One and a half years have thus been scheduled and subdivided among various departments with a view to preparing the apprentice for any line of work in the railway field, which may happen to be open to him. He has had the opportunity to demonstrate his peculiar abilities and disabilities, and if he has "stood by" for the full period, he has shown his appreciation of the opportunity. It is obvious that a very large company could handle a number of such apprentices without serious difficulty, if the officers in charge of them were in hearty sympathy with the idea. The plan requires the coöperation of the heads of all departments, and there are numerous objections which appear as soon as the scheme is suggested. The young men are in the various departments such a short time that they are not able to work at maximum efficiency. Further, it requires a little effort on the part of the superintendents of the various departments to lay out the work for the apprentices. The young men are apt to leave, and thus the company loses the benefit of the effort expended. On the other hand, opportunities are constantly arising in every company, demanding loyal, well-trained employes. These are difficult to obtain and could be picked out instantly from the apprentice corps. Smaller companies by

slight modifications could use the same general plan, and with the same results.

The matter of pay for the apprentices is one of practical importance. It is not to be expected that they will be able to earn as much as men regularly employed in the departments. On the other hand, they should be expected to earn for the company as much as possible. Their wages should be based more upon a reasonable living expense, than upon their earning capacity. This will depend upon the cost of living in various communities. Probably from 10 to 12 dollars per week at the start, with a reasonable increase at the end of each six months' period would be reasonable and satisfactory to all concerned.

This paper is not intended to recommend that companies go into the apprentice business on a wholesale scale. If each year one or two men could be employed by the smaller companies, and half a dozen or so by the larger companies, there would be a sufficient supply of new material always in processes of development. Of the men hired probably one-half would drop out before the end of the period, and those who remain would naturally be the ones best fitted for the work.

Freight Service on Electric Railways.

Two papers dealing with the handling of freight by electric railways were presented at the recent convention of the American Street & Interurban Railway Association. A paper by Mr. P. P. Crafts gave a brief description of the freight business conducted by the Iowa & Illinois Railway Company. Within the first year, with only one freight car engaged in the business, and the use of passenger coaches for carrying some freight, the income reached a total of more than $10,000. On package freight the railway is able to lessen the time of the steam railroads by 24 hours between Davenport and points on the Chicago & Northwestern Railway. A specialty is made of rush orders by telephone. The earnings from the freight business amount to 15 per cent of the total income of the electric railway.

The second paper was presented by Mr. H. H. Polk, who stated that farmers, merchants and manufacturers prefer to ship freight over the electric railway rather than the steam railroad. Moreover, the steam railroads prefer to handle freight in car-load lots rather than package freight. The less-than-car-load shipments on the Colfax division of the Interurban Railway Company (Des Moines, Ia.) are handled in express cars, at freight rates. Car-load shipments on this division are handled by an electric locomotive when necessary. On the Beaver Valley division a way-freight leaves Des Moines at 4 o'clock in the morning. This train is composed of an electric locomotive, merchandise cars, car-loads, and a caboose. It picks up all car-loads and does all the switching at the various stations, out and back, setting loaded cars and empties at the various elevators, stock-yards, coal mines, etc. The author suggested that each station along the electric railway should have a freight-room in charge of the station agent, who should receive and issue train orders, sell tickets, and solicit passenger as well as freight business. Data were given to show that the energy consumption of freight trains making a speed of 15 m. p. h. between stops varies from 19 watt-hours per ton-mile at the locomotive for a gross weight of 500 tons to 28 watt-hours for a weight of 100 tons. The energy consumption of interurban cars reaching a maximum speed of 45 m. p. h. varies from 67 watt-hours per ton-mile for a 50-ton car making one stop per two miles to 92 watt-hours per ton-mile for a 20-ton car making one stop per mile. The cost of repairs and maintenance of a 40-ton locomotive equipped with direct-current motors when hauling a 200-ton train about 100 miles per day will average about 1.5 cents per locomotive mile. This includes repairs to motors and control equipment and the care of the locomotive. The cost of repairs and maintenance of interurban cars will average about 1.5 cents per car-mile. This value includes cost of repairs to motors and control equipment and the cost of cleaning the car bodies.

The Atlantic City Street Railway Convention.

The convention of the American Street and Interurban Railway Association and its affiliated bodies at Atlantic City, N. J., Oct. 14 to 18, was the largest ever held by that body. Certainly the exhibits made under the auspices of the Manufacturers' Association exceeded in number, character and interest any exhibit ever made in the history of the composite organization. The character of the papers presented and the interest manifested in them, especially in the report of the committee on standardization, indicate that the American Street and Interurban Railway Association is taking its place among the other great national organizations. The list of incoming officers of the various associations included in the American Street and Interurban Railway Association is published elsewhere in this issue.

Last week's issue contained abstracts of a number of the papers presented, together with the discussions on these to the close of Tuesday's sessions. Below are given abstracts of papers not previously published, and of the discussions which followed the reading of them and of the papers read at the Wednesday sessions.

The annual report of the secretary and treasurer of the American Street and Interurban Railway Association presented at the opening session of that body on Wednesday, showed that the number of active members in good standing is 227, the associate membership numbers 148, and the total receipts were $31,701.

The report of the standardization committee of the Engineering Association was presented at this meeting and was adopted by unanimous vote. The first paper presented was entitled "The Technically Trained Man and the Electric Railway Profession," by Prof. H. H. Norris. The abstract of this paper was inadvertently omitted from last week's issue and will be found on page 810 of this issue.

TECHNICAL GRADUATES FOR ELECTRIC RAILWAYS.

The discussion on Prof. Norris' paper was opened by Mr. H. W. Blake, of the *Street Railway Journal*. Mr. Blake referred at length to the compilation of universities, colleges and technical schools of this country published in the July 27 number of the ELECTRICAL WORLD, and said that while no statistics were obtainable as to how many graduates had entered the electric railway field, it was safe to say that many of them are prepared to do good service in this branch of electrical engineering. The mental discipline received enables the graduate to adapt himself quickly to practically any department in which he may be placed. He said that the paper suggests a concrete plan by which the results secured in other branches of the electrical industry in utilizing the college graduate may be carried out by street railway companies. The proposed course of 18 months should form an excellent method for learning the practical application of the principles acquired at the university, and the establishment of a trained corps of men in the way suggested should be of great future assistance to the railway companies.

Mr. Blake was followed by Prof. Richey, of the Worcester Polytechnic Institute, who related his experience with graduates when he was connected with the Indiana Union Traction Company, and also spoke of the course in electric railway engineering at the Worcester Polytechnic Institute. C. S. Sergeant, while believing in rotation from one department to another as outlined in Prof. Norris' paper, criticized the brevity of the course in each department. There is danger, he said, that the young man who flits about from a couple of months in one department to a month and a half in another will think he knows it all in a year or two. Mr. Wyman said his firm was fortunate to secure from 10 to 20 graduates, who were instructed along the line of investigating statistics derived from the operation of its various companies. After being given a broad and general view of the principal lines of work, they were willing and anxious to undertake practical work with some of the different companies

controlled by his firm, eventually becoming superintendents, managers or presidents of the various companies.

W. H. Evans said much depended on the apprentice. He had employed four apprentices and felt that they would fail unless they got down to the level of those with whom they associate. They must disabuse their minds of the fact that they are there to gain all and give nothing. W. Saryl Ely said that it was a mistake to think that a man has to be born with a red flannel shirt on him to enable him to get down to good, hard, common work that greases his hands and smuts his face. C. L. S. Tingley thought the time allotted to the apprentice in the accounting department was too short.

Ralph Sweetland, of the New England Insurance Exchange, then read his paper, entitled, "The National Fire Protection Association and Its Work in the Street and Interurban Railway Field." Mr. Sweetland stated the objects of the National Fire Protection Association, the character of the work performed by it, and closed by inviting the street railway association to take an active interest in the wok of the fire protection association so that the enormous fire waste, amounting in the United States this year to nearly $185,000,000, may be diminished. At the suggestion of Mr. McClellan the paper by Mr. Campion and himself, entitled, "The Influence of the Design of Railway Structures on Economy of Operation," was read by title, the hour for adjournment of the morning session having passed.

At the closing session of the Engineering Association on Wednesday afternoon the first paper presented was the one by Paul Winsor, an abstract of which will be found on page 809. In opening the discussion G. W. Farmer enquired if 3.447 lbs. of coal per kw-hour was the average of all the Boston elevated steam plant consumption. J. W. Corning said it was the average of all but an old non-condensing plant operated only on peak loads. In reply to Mr. Farmer's question asking if comparisons were available as to the total cost of energy per kw-hour delivered from the gas plant and the average steam plant, including supplies, repairs, etc., he said that such figures were undoubtedly available. J. R. Bibbins said he had in mind two plants giving practically the same figures.

DISCUSSION ON THE STEAM TURBINE.

Mr. Chilton then read his paper entitled "Some Practical Points in Steam Turbine Construction, with Particular Reference to the Parsons Type," an abstract of which appeared in last week's issue. This paper was followed by one prepared by A. H. Kruesi, entitled, "Operation of Curtis Turbines in Railway Service," an abstract of which was also published in last week's issue.

Mr. Roberts, referring to the last part of Mr. Kruesi's paper, relating to the guarantee of the boiler makers of 200 lbs. for a boiler practically guaranteed for 150 lbs., thought that in so far as superheated steam is concerned the increase of 50 lbs. was advisable; but whether the boiler makers would stand by the tubes or not under those conditions was questionable. With increased pressure he felt there should be some different construction in the boiler. Mr. Kruesi, he said, failed to point out that the great increase of maintenance means a great drawback to the use of both economizers and superheated steam. One thing, he maintained, should be pointed out to those contemplating the purchase of turbines, and that is that under varying loads at varying steam pressures the turbine can be depended on to do work that a reciprocating engine cannot. He mentioned a recent incident where his company had seven 300-hp boilers working over natural gas, and the remainder of the boiler equipment, five 300-hp boilers, was being fired up. The steam pressure dropped to 85 lbs., and yet the turbine was operating at that pressure and carrying all the load possible, while a 1500-hp and an 800-hp reciprocating engine were working with their valves wide open and were inclined to "lay down." He advised the avoidance of water step-bearings for turbines, and the substitution of oil step-bearings. The trouble with water step-bearings is that though they have practically pure water, eight gallons of water are used per minute on the step bearing, which at 6 cents per 1000 cu. ft. amounts to about $7 in 24 hours, and this would pay for a large amount of oil. Besides very slight impurities in the water seriously affect the face of the bearings so that frequent renewals are necessary. With regard to auxiliaries, he said, he would not use a steam-driven circulating pump and would have a barometric condenser. His company is operating its condenser with a dry vacuum pump and is getting from 28 ins. to 28½ ins. of vacuum at 1080 ft. above sea level. This is practically 29 ins. The trouble is to get the water over without a dry vacuum pump; but once the water is over, the vacuum is assured. The pumps should be electrically driven.

Mr. Mitchell said that his company has two turbines with water step-bearings in operation, and that the water from the bearings is used for boiler feed purposes. Mr. Roberts said that the water from the step bearings ordinarily goes into the discharge end of the turbine and is wasted; but Mr. Mitchell said his ran into the service connections. He also stated that surface condensers are more satisfactory and give the best boiler water. The cooling water often is very dirty and he was obliged to use a surface condenser to get good feed water.

Charles Hewitt doubted if there was much to choose between water step-bearings and oil step-bearings, or between surface condensers and barometric condensers. He had no trouble with water step-bearings for two years. F. E. Henshaw thought it might be interesting if Mr. Roberts, who advocated electrically-driven auxiliaries, would expound a little further on that point since there were many who regarded them with disfavor. He thought steam drive was preferable to any secondary source of power. He had seen boiler-feed multi-stage pumps driven by steam turbines in the Waterside Station of the New York Edison Company.

Mr. Roberts in reply stated that the pumps in his station are driven by a vertical engine. The speed his company desires to operate at is 480 r. p. m., which is a natural speed for an alternating-current motor. The speed of the engine has to be increased to 430 r. p. m. occasionally to get the water over the head. That is why he favored motors. His company has another plant in which the pump is motor-driven and the plant was not shut down four hours a year because of any trouble with the motor-driven pump.

Mr. C. F. Baker thought the troubles mentioned by Mr. Roberts could be overcome by increasing the size of the rotor in the pump so that the engine speed would be sufficient.

Dudley Farrand said that the Public Service Corporation of New Jersey had changed from water step-bearings to oil step-bearings, and had found the change advantageous, although the water step-bearings gave the company no serious trouble. The use of oil step-bearings enabled the turbines to run with greater clearance. His company is using surface condensers on all its turbines. As to first cost, Mr. Farrand said he did not see how any company can afford to put in any other than turbine units in large installations.

Mr. Mitchell said that the Edison station in New Orleans had supplanted all its electrically-driven auxiliary apparatus by steam-driven units. Mr. Farmer stated that the Old Colony Street Railway Company had a similar experience. In Quincy all the auxiliaries were electrically driven, and while they expected great results from electrically-driven apparatus, they found it advantageous to change from electric drive to steam drive. The operation of the plant was much more flexible with steam-driven units, and besides exhaust steam was needed for heating the feed water. His company was forced to use surface condensers at Quincy because the feed water had to be purchased and salt water was used for circulating in the condensers. The water from the step-bearing discharges directly into the condenser at the Quincy station. Oil step-bearings are used at the Newport station, and in each case the operation is such that no change is contemplated.

Mr. Farmer asked Mr. Kruesi if the figures quoted for the percentage in gains in economy for steam pressure, vacuum and superheat are those which apply generally for all sizes of machines, to which the latter replied that they did; so did the 1 per cent for every 12.5 degrees of superheat.

Mr. Kreusi, in replying to Mr. Roberts, said in regard to water-step bearings that he was safe in saying there are over 100 machines operating satisfactorily in various parts of the world with water-step bearings. Similar reports have been made of satisfactory operation with oil. He thought Mr. Roberts' trouble was due to the deposit of salts on the lower wheel, caused by the spraying of the water in passing the turbine which would throw the latter out of balance. A similar case arose where good water was not available in Cuba and one or two other places, and it may be necessary to design oil-step bearings for these machines, such a case being cited in his paper. With reference to Mr. Roberts' difficulty with boiler tubes, he said, any number of instances might be cited where satisfactory operation has been had with boilers at 175 lbs. and 190 lbs. pressure in connection with steam turbines. In the same way he believed it to be an error to condemn engine-driven circulating pumps, because in one particular instance the pump was designed for too high speed. A circulating pump for the conditions such as Mr. Roberts had to deal with can be designed for a wide range of speed and there is no reason why it could not be designed for 75 r. p. m.

The question of motor-driven or engine-driven auxiliaries was too large to be entered on. Motor-driven auxiliaries are open to the same objections as motor-generator exciter sets. Sufficient steam could be had for motor-driven auxiliaries by taking steam from the first and second stage. All Curtis turbines are furnished with openings so that if any one desires to heat water in that way it can be done. The turbine uses the steam down to the point where all of its energy is abstracted, and has a higher efficiency than most of the engines which would be used for driving auxiliaries so that it would be economical to use no steam-driven auxiliaries. There are other objections on the score of reliability with motor-driven auxiliaries which would off-set that. He thought the turbine-driven auxiliaries are absolutely reliable. They have been used in several instances, and he expected very rapid increase in their number. Many troubles due to the auxiliaries are laid to the turbine just because they went in at the same time as the turbine. He thought many of Mr. Roberts' troubles were really condenser troubles. With reference to the point raised by Mr. Roberts on steam consumption, he quoted a statement from the last report of the turbine committee of the Edison Association to the effect that engines are no longer in the same class with turbines as to steam consumption.

With regard to the figures of superheat, pressure and vaccum, Mr. Kreusi said such statements as he had made must naturally be general unless he gave tables applying to each particular turbine, showing the percentage of improvement to be gained from a given amount of superheat. This would depend upon the size of the turbine, because a 1000-kw unit, for example would have a water rate of about 20 lbs., whereas a 5000-kw turbine would have a water rate of 17 lbs., and naturally 1 per cent on 17 lbs. is different from 1 per cent on 20 lbs. He could make statements as to the gains obtained from superheat, which would naturally be different from that guaranteed. There must be a margin in the guarantee. No conservative manufacturer will guarantee up to the full limit of gain which he knows will be realized, and that might account for the difference between 12 and 14 degs.

J. R. Bibbins then read an abstract of his paper entitled "Recent Developments in Steam Turbine Power Station Work," and in conclusion presented some results of the test on the turbine installed in the New York Edison Company's Waterside Station No. 2. The details of this test appeared in our issue of Oct. 12, and an abstract of Mr. Bibbins' paper was published last week. After the reading of Mr. Bibbins' paper, officers for the ensuing year were elected, and the sessions of the American Street & Interurban Railway Engineering Association were brought to a close.

At the Thursday morning session of the American Street & Interurban Railway Association, the committee on "Rules for the Government of Motormen and Conductors" presented its report of progress. Following the report Mr. P. P. Crafts read his paper entitled "Light Freight Handling by Electric Lines." He added that a 20-per cent reduction in tariff required by the railroad commission of Iowa has resulted in an appreciable increase in the amount of freight carried. Mr. Crafts also described the blanks and sheets used in conducting the freight business.

The paper, "Freight Service on Electric Railroads," by Mr. H. H. Polk, was next read and both papers were opened for discussion at the same time. Abstracts of these two papers are given on page 811. Mr. C. E. Emmons said that his company's last year's accounts show that the freight business was responsible for about 60 per cent of the gross receipts. In the territory covered by his company, the freight business is a large factor in the development of the company's properties. Mr. E. F. Peck stated that the Schenectady Railway Company is operating a freight and express business to its profit. Mr. J. H. Pardee said the matter of a paying or non-paying freight business depends on the locality. He felt, however, that there was profit in the freight-handling business. Mr. C. L. Allen was of the same opinion. Mr. Hippee said he would rather have the freight business than the passenger business, if for no other reason than the question of hazard. Mr. W. S. Dimmock stated that his company has in service between 300 and 400 freight cars and that the business handled is such that he wished he had 200 more cars.

The paper on "A Department of Publicity," by Mr. J. H. White, was then presented, followed by one on "Advertising from the Street Railway Standpoint," by Mr. A. W. Warnock. The former paper described the work of the publicity department of the Boston Elevated Railway Company, and the latter paper was devoted to the admirable publicity work of the Twin City Rapid Transit Company. There being no discussion offered on these two papers, the paper prepared by Mr. H. S. Cooper, entitled "Problems of a Small Road," was then presented. Mr. Cooper's paper dealt with the organization of the various departments, the direct and personal relations with its patrons and the problems connected with employes and materials. After commenting on the excellence of the paper, President Beggs adjourned the meeting.

The first committee report presented on Friday was on "Insurance." The report pointed out that a large part of the cost of conducting insurance business consists of commissions paid to agents, brokers, etc. This item of expense could be eliminated either by cooperation among traction companies to mutually insure their own properties, or by direct arrangement with existing insurance companies without the intervention of middlemen. H. N. Staats gave the names of three insurance companies organized to permit electric railway companies to carry their insurance at cost.

The report of the committee on "Rules for the Construction of Modern Car Houses" was then presented and on motion was adopted and its recommendations earnestly commended to companies about to build or overhaul car houses.

The report of the committee on "Municipal Ownership" was accepted. It was followed by the reports of the committee on "Heavy Electric Traction" and on "Compensation for Carrying Mail." Mr. C. G. Reel's paper on "The Use of the T-rail in Cities" was then read. The author pointed out that the T-rail can be used and is used in many cities without in any way interfering with the condition of the street pavement.

A paper entitled "Public Policies of the Past and Future," by Mr. C. L. Allen, was then read by title. A paper entitled "Interurban Railway Fares," by Mr. T. Stebbins, was next presented, followed by one on "Municipal Ownership in Great Britain and in the United States," by Mr. W. J. Clark. The committee on "Public Relations" then presented its report for acceptance.

Before the association adjourned *sine die* Mr. W. C. Ely presented the following resolution, which was adopted:

"Whereas, Experience has demonstrated the desirability and usefulness of our existing affiliated organizations; and

"Whereas, It has appeared from discussion that another organization of similar character should be organized, to which

should be committed lines of work pertaining to transportation, traffic and general operation, now, therefore, be it

"Resolved, That the executive committee be, and hereby is, requested to take such steps as it may deem desirable to encourage the formation of such an organization."

New Telephone Patent.

MULTIPLE SWITCHBOARD BUSY TEST.

The busy test for multiple switchboards has almost always been made by the introduction of a sudden slight current upon the operator's set. At first the best current flowed through the receiver directly, but of late a tertiary has been provided upon the induction coil to receive the test impulse and inductively repeat it in the receiver circuit. In many systems, where the test circuit is entirely independent of the talking circuits, the test current is fed to the tertiary direct. Where with the two wire systems, however, the test and line contacts are common, the diversion of a sufficient amount of current to cause a satisfactory busy sound, will disturb the busy line. With such systems it is usual to provide a very sensitive relay of high resistance to receive and be operated by a very minute diverted current. Then the contacts of this relay apply a secondary audible current to the operator's tertiary. It is readily seen that with this arrangement an appreciable time elapses between the contact of the testing plug and the click which, if the test contact be brief, may result in a false move by the operator. Mr. W. W. Dean has endeavored to reduce this time interval by reversing the action of the test relay. He causes the test relay to maintain the secondary circuit through its back or normal contact. This circuit becomes severed at the first move of the armature, thus quickening the test. The secondary circuit is not closed except when the supervisory relay of one or more cards is pulled up. The patent for this system is assigned to the Kellogg Switchboard and Supply Company.

Recent Electrochemical Developments.

BATTERIES.

A recent improvement in the old Edison-Lalande cell has just been patented. In the original cell, zinc and copper oxide electrodes are used in potassium hydrate as the electrolyte. Mr. Edison has now found that by adding silicate of potash to the electrolyte, its solvent power or the capacity of the solution for zinc is more than doubled. The best composition is to add to a 20 per cent hydrate solution about 15 per cent of potassum silicate.

This cell may be modified and used as a secondary battery by employing nickel hydroxide as depolarizer, while a plate of metallic magnesium is used to receive the zinc deposit plated out of the alkaline zincate solution by the charging current. In this modification the proportions of potassium hydroxide and of the alkaline silicate can be increased conveniently, because there is less likelihood of the solution freezing than with primary batteries which are frequently employed in exposed places.

FERRO-ALLOYS.

We have already referred in these columns to the extensive work which is being done in the production of ferro-alloys in the electric furnace by Messrs. F. M. Becket and E. F. Price, of the Electro Metallurgical Company. Numerous patents recently granted to these inventors give much information concerning a number of interesting electrochemical relations.

One is the extensive use they are making of silicon as a reducing agent. It is, of course, now well understood that steel manufacturers want ferro-alloys free from carbon, and that aluminum has been used successfully as a reducing agent for making such alloys. Messrs. Becket and Price use silicon in various forms, mostly in the form of a high-percentage ferro-silicon. They have also found carborundum, that is carbon silicide, to be quite suitable. Mr. Becket states that in this case high yields of a product low in carbon may be obtained, since the portions of the metal first reduced do not come into contact either with free silicon or free carbon and, therefore, do not absorb the same to any injurious extent.

An interesting special application of silicon as a reducing agent is the direct reduction of vanadium sulphide to metallic vanadium, Si_4S_2, being formed.

A basic flux is, of course, used in these processes to take care of the silica which is being formed during the process and of that which may be already contained in the ore under treatment.

Silicon, however, is a comparatively expensive reducing agent, and it is, therefore, advisable to restrict its quantity as much as possible. As is often true in metallurgy, this may be accomplished by breaking up the process into various steps. For instance, the reduction of vanadic oxide, V_2O_5, is best carried out in two successive operations; first the vanadic oxide is reduced to a lower oxide, V_2O_3, by means of carbon in a gas furnace, and then the V_2O_3 is reduced to elimentary vanadium by means of silicon in an electric furnace. This method results in a considerable saving of electric energy and of silicon, which are two expensive items in the cost sheet.

Finally, it is a fact that even if silicon is used as the reducing agent, some carbon will come into the reduced metal, chiefly from the carbon electrodes. To obviate this as much as possible, Mr. Becket proposes to make the carbon cross-section as small as possible, and, since this renders a high current density necessary, he protects the carbon ends against premature deterioration by special water cooling devices.

Letter to the Editors.

Distortion in Telephonic Transmission.

To the Editors of Electrical World:

Sirs:—The writer has read with great interest the article by Mr. Louis Cohen and the editorial in your issue of Sept. 21, on "Distortion in Telephonic Transmission." The increase in attenuation due to "skin effect" in the large wire under consideration, is interestingly shown, and is of value as not having usually been considered by previous mathematical investigators. That this causes any noticeable proportion of the distortion in telephonic transmission, however, does not follow.

The case considered by him is one which would show the greatest possible distortion due to "skin effect," as to the best of the writer's knowledge the line cited is of the largest diameter in commercial use for telephonic transmission. Ninety-nine per cent of telephonic connections are over wires of smaller diameter than this, where the "skin effect" is far less.

A 500-mile length of a line of the constants mentioned, with no auxiliary apparatus or cable at either end, will give as nearly perfect speech transmission as is ever found in telephonic service. Such a connection would be many times clearer than the average short-distance conversation in a city where cable is used, and it would be impossible to detect the small percentage of distortion indicated by the attenuation calculations. Indeed, it might be shown by carrying the calculations further, that the distortion due to the essential apparatus of the telephone instruments themselves is greater than that of the line in question.

Each piece of auxiliary telephone apparatus, such as a relay, repeating coil or condenser, produces greater distortion than that of the line mentioned. The combination of such apparatus with a number of miles of No. 19 or No. 22 B. & S. gauge cable, such as is largely used for telephonic transmission, may give a difference of attenuation of several thousand per cent between the frequencies of 200 and 2000, and still give good commercial transmission.

As an example, take the simple case of a 25-mile length of 19 gauge cable, loop resistance 90 ohms, and mutual capacity .08 m. f. per mile, with a local battery instrument at each end. If the instruments are equipped with cut-out buttons to short-circuit the secondary winding of the induction coil, they

may be considered as equivalent, when listening, to having the receiver bridged across the line.

The self-induction and skin effect of such a line may be shown to be practically negligible, and the receiving and impedance is represented by the formula:

$$Z_r = Z_1 \sinh ax + Z_a \cosh ax \text{ *}$$

where Z_1 is the line impedance, Z_a the impedance of apparatus at the terminal end, and $a = \sqrt{jrc\omega}$. Assuming for the receiver, $R = 60$, $L = .1$ ($g = 0$, $l = 0$) we have for the frequencies of 200 and 2000 p. p. s.

200 p. p. s. $Z_r = 2518 \ /58° \ 30'$ ohms.

2000 p. p. s. $Z_r = 111{,}000 \ /380°$ ohms.

This result is rather startling, and shows the full effect of distortion, both as regards attenuation and phase relation of wave components. It is still more striking when one considers that this hypothetical circuit does not represent the extreme limit of possible conversation. Fair conversation is possible over such a length of cable and through all the auxiliary apparatus of a modern exchange system, although the distortion would be much greater than the above, and poor conversation is possible over 10 or 15 additional miles of cable.

This simple example will show that the distortion occurring in cable circuits is very many times greater than that due to "skin effect," even where the largest commercial telephonic conductors are used.

In a mixed circuit composed partly of aerial wire and partly of underground cable (a typical long-distance connection), it is readily seen that the distortion in the aerial line is very small compared to that in the cable and apparatus at either end; so that the distortion due to "skin effect" in telephonic transmission is usually a negligible factor in the total distortion of a telephone connection, and is always an unimportant one.

The case calculated is also interesting as indicating that a frequency of 2000 p. p. s. is higher than the maximum which it is necessary to transmit to give intelligible speech.

Chicago, Ill. W. C. Yeatman.

*Kennelly. *Transactions* Int. Elec. Cong., 1904, Vol. 1, p. 73.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Train-Lighting Dynamo.—M. Osnos.—A description of a new train-lighting dynamo built by the Felten & Guilleaumme-Lahmeyer Company. The voltage is maintained automatically constant within wide limits of speed, and the current has always the same direction whatever the direction of rotation. The dynamo itself has no special features; the novelty rests in the exciter. The voltage of the exciting machine decreases with the speed and reverses its direction with the direction of rotation of the machine. The principle is shown in Fig. 1, in which

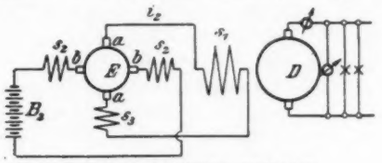


FIG. 1.—TRAIN-LIGHTING DYNAMO.

D is the dynamo, which gives the current for lighting the lamps; s_1 is the exciting winding of this dynamo, and is supplied with current from the brushes, aa, of the exciter, E. The exciter has another pair of brushes, bb, in series with the winding s_2. The exciting current is furnished by the battery B_2. The turns of the winding s_3 are adjusted when testing the machine so as to get the correct intensity of the armature "quadrature field." The battery B_2 is charged from the dynamo D. The principle of operation is as follows: The current i_2 which is taken off from the brushes a produces an armature field in the direction of these brushes. In this "quadrature field" the armature rotates and there is, therefore, at the auxiliary brushes bb an e. m. f. e_2 which counteracts the battery voltage e_1 so that the exciting current of the exciter is $i_2 = k_1 (e_1 - e_2)$ where k_1 is constant. Since e_2 is produced by the rotation of the armature in the field generated by i_2, $e_2 = k_2 i_2 n$ where n is the speed and k_2 is another constant. Thirdly, i_2 is produced from the e. m. f. between a and a which is due to the rotation of the armature in the field produced by i_1 so that $i_2 = k_3 i_1 n$. From these three equations it follows that the exciting current i_2 of the main dynamo D bears the following relation to the speed n.

$$i_2 = \frac{n}{a + bn^2}$$

where a and b are constants. Since n is in the numerator and n^2 in the denominator it follows that i_2 decreases with n beginning with a certain value of n. By a suitable choice of the constants a and b, which determine the magnetic properties of the exciter, it is possible to predetermine the point from which i_2 begins to decrease. When the direction of rotation is reversed, the voltage of the exciter and, therefore, the exciting current of the main dynamo D, changes in direction. The voltage of the main dynamo D, therefore, has always the same direction whatever may be the direction of rotation. In order to get good results, the exciter must be saturated in a peculiar way. The author finally shows how it is possible to use the exciter itself as a train-lighting machine.—*Elek. Zeit.*, Sept. 19.

Alternators in parallel.—F. Emde.—Goerges has formerly pointed out that in the operation of alternators in parallel the damping winding does not always diminish the oscillations of power, but makes matters worse if the frequency of the free oscillations of the pole wheel is below 0.707 times the frequency of the forced oscillations. Rosenberg has also discussed the matter in great detail. The present author endeavors to discuss the same subject from a new and simple point of view by means of diagrams.—*Elek. u. Masch.*, Sept. 22.

Compound Alternators.—J. Rezelman and J. Perret.—A mathematical note illustrated by diagrams on a method of compounding alternators.—*L'Eclairage Electrique*, Sept. 7.

Testing Dynamos.—C. F. Guilbert.—The first part of an article illustrated by diagrams on practical methods of determining the characteristic curves of dynamos and motors. The author first discusses direct-current dynamos.—*L'Eclairage Electrique*, Sept. 14.

Lamps and Lighting.

Metallic-Filament Lamps.—A note on a recent British patent of the British Thomson-Houston Company according to which in the manufacture of metallic filaments for incandescent lamps water-gas is used as an inert or reducing atmosphere in which to treat the filaments. Its advantages are low thermal conductivity and cheapness.—Lond. *Elec. Eng'ing*, Oct. 3.

Quartz Lamp as Competitor of Arc Lamps.—O. Bussmann.—His full paper on the quartz lamp of Küch, which is a high-efficiency mercury-vapor lamp with a life of 1000 hours, and is intended to compete with high candle-power arc lamps.—*Elek. Zeit.*, Sept. 19. A long illustrated abstract of this paper was given in last week's issue on page 769.

Melting Point of Pure Tungsten.—H. von Wartenberg.—Pure tungsten was melted in a vacuum tube and the melting point found to be between 2800 deg. C. and 2850 deg. C. (between 5072 deg. F. and 5162 deg. F.).—From *Berichte*, 1907, v. 40, p. 3287, abstracted in *Jour. Soc. Chem. Industry*, Aug. 31.

Power.

Electricity in the Austrian Iron Industry—W. Kestranek.—An Iron and Steel Institute paper, in which the author states that the most extensive application of electricity is found everywhere in Austrian iron and steel works, mostly in con-

junction with blast-furnace gas engines, and also coke-oven gas engines for the generation of power; as an example, in Witkowitz a plant of this description of 5700 horse-power exists. At the Austrian blast furnaces which yield 790,000 cu. meters of gas per hour, 263,000 cubic meters are used for blast heating, so that 527,000 cubic meters are available. Of this quantity, at the present time, 358,000 cubic meters, or 68 per cent, are utilized for boiler heating, and 34,000 cubic meters, or 6.5 per cent, representing 12,000 horse-power, in gas engines, whilst the remainder of the gas is used partly for ore-roasting or in drying kilns, and partly drawn off unutilized. The Böhmische Montangesellschaft, which at present is utilizing blast-furnace waste gases on the most extensive scale, utilizes 23 per cent of the available gas in gas engines. In the Austrian coke works, the coke ovens yield 86,000 cubic meters of gas per hour, of which quantity the coke ovens themselves absorb 62,000 cubic meters, so that 24,000 cubic meters are available. Of this quantity 5700 cubic meters, or 24 per cent, are utilized in gas engines, whilst the remainder is used for boiler heating. The most complete application of electricity to the driving of rolling mills is in Teschen, where, not only the finishing, intermediate and roughing trains, but also the reversing rolling-mills are driven by electric motors. High-grade alloy steels, especially tool steels, are now being made in various Austrian plants in the electric furnace, the Kjellin process, Keller process and the Heroult process being used. The author also speaks of the importance to the iron industry of sufficiently high protective import duties, of the association of iron works into a syndicate, and of the concentration of smaller works into larger units.—*Electrochem. and Met. Ind.*, October.

Italian Transmission Plant.—An illustrated description of the transmission system from Caffaro to Brescia. The energy is furnished to a caustic soda factory in Brescia, and is also used for lighting and power purposes in the cities of Manerbio, Brescia, Cremona and Ponte Viggio. There will be five sets of machines, each of 2500 horse-power, of which four are already in operation. The generating e. m. f. is from 9000 to 10,500 volts. The e. m. f. is raised in transformers to 40,000 or 46,000 volts for transmission to a large distribution and transformer station in Brescia, where the e. m. f. of part of the energy is transformed down to 3600 volts, while the balance is transmitted at 36,000 volts to the other cities mentioned above.—*Schweiz. Elek. Zeit.*, 1907, pp. 2, 13, 27 and 37; abstracted in *Elek. Zeit.*, Sept. 26.

Power Plant.—J. Reyval.—A Swiss company is erecting at present two new hydro-electric plants of large capacity. The first is located in the district of Glaris, in Switzerland, and will have a maximum output of 36,000 horse-power, furnishing energy exclusively for lamps and motors to this very active industrial district. It will be electrically connected with the generating station at Beznau. The second plant utilizes the falls of the Tessin River, in the Biaschiana district. Various data are given on the hydraulic development of the latter station.—*L'Eclairage Electrique*, Sept. 14.

Peat as Fuel.—A net work of canals, of a total length of 24 miles, has been built in an extensive peat district in northern Germany, and a large electric station is to be erected which will furnish primarily energy for the operation of electric ploughs and other machinery needed for rendering the peat district available for farming. Energy is also to be transmitted for lighting and power purposes to various cities within a distance of 13 miles. Peat will be used exclusively as fuel in the station.—*Elek. Zeit.*, Sept. 26.

Charging Apparatus for Blast Furnaces.—G. Meyer.—A fully illustrated detailed description of the electric equipment of the charging apparatus for the blast furnaces in a German works. It is stated that the Ward-Leonard system of control has proved very successful for such work.—*Elek. Kraftbetr. u. Bahnen*, Aug. 3.

Electric Winding in Mines.—L. Becker.—A very long mathematical article discussing the advantages of the Ilger system and endeavoring to refute the objections which have been raised against it. The author discusses in detail the different mechanical and electrical losses, and shows how to determine the most favorable slip necessary to allow the flywheel to take up the variations of load.—*Elek. Kraftbetr. u. Bahnen*, Sept. 4, 14 and 24.

Traction.

Municipal Tramways Association.—A full account of the Manchester convention of the (British) Municipal Tramways Association. In A. L. C. Fell's paper on "rail corrugation" the importance of the initial condition of the rail was insisted on, and the weight of the discussion which followed also emphasized the predominance of the rail as a factor in producing the evil, although the usual contradictory variety of opinions was expressed. J. Dalrymple in his paper on "Staff Organization" placed particular emphasis upon the necessity of the head officer of a tramway department having effective control over all parts of the work, even though the actual execution might be entrusted to other officers, and he laid down a scheme of organized development which is designed to leave the general manager free to manage, whilst the detail executive work is distributed among subordinates responsible to him. An advocacy of "Long Wheel-base Trucks," by Acland, revealed much difference of opinion on the subject of truck design, the present English practice in which is generally felt to be unsatisfactory in several particulars. In the course of the discussion, an account was given of a new type of truck now under trial at Burnley. Baker contributed a paper summarizing the conditions of employment in municipal tramways throughout the United Kingdom, provoking a discussion on rates of pay and other labor conditions generally, the greater part of which was held in private. The subject of the maintenance of the paving of tramway tracks and margins was brought forward by F. Spencer, and relegated to the executive committee to consider collective action. The new president is Aldworth, of Nottingham.—Lond. *Elec. Eng'ing*, Oct. 3.

Rail Corrugation.—A. L. C. Fell.—His paper read before the (British) Municipal Tramways Association. After study and investigation on various tramway systems, the author has come to the conclusion that corrugations are not due entirely to one cause. The following are, in his opinion, some of the chief producers of the trouble: (1) Original roughness of rail after rolling; (2) cold rolling of rails by the car wheels; (3) soft rails and heavy cars; (4) sand and grit on head of rail; (5) defective and open joints; (6) tight or wide gauge of track or wheels; (7) loose or springy rails and points; (8) defective trucks being out of square and buckling; (9) slip of wheels at curves; (10) wheels not being of same diameter; (11) flats on wheels; (12) rapid acceleration and retardation, causing wheels to slip; (13) defective brake mechanism, or by too rapid application of the brakes, causing chattering and a series of short skids. Any of the above matters may be responsible for the trouble, but the author still considers that the "original sin" is produced when the rails are rolled, and it will quickly develop into corrugation unless the surface of the rails is ground immediately after they are laid. On the Vauxhall to Victoria route of the L. C. C. tramways the rails were rubbed with carborundum blocks before electric cars began to run. Distinct signs of corrugation then appeared, and were ground out. A heavy service of cars has been in operation over these lines during the past 14 months, and there are only very slight signs of corrugation, except on the Vauxhall Bridge crossing the Thames, where the corrugation is more serious. This is, no doubt, due to the spring of the rails on the bridge. In another case where fully developed corrugations along the Clapham Road were rubbed out in a similar manner at the same time, the rails are now badly marked again, the service of cars and the speed in each case being practically the same. An important question which has to be answered before the root of the evil can be discovered is: Why are corrugation waves the same length with varying speeds within certain limits, say, from 4 to 16 miles per hour? One possible explanation is that corrugation may be in some instances caused by the cold rolling of the rail by the car wheels. With a light car, such as a horse car, the rolling is almost imperceptible. With a heavier

electric car the weight is sufficient to start cold rolling, and a wave starts at the softest part of the rail and travels forward until the weight of the car is not sufficient to carry the wave further; the wheels then ride over the top of the wave and violent oscillation is set up and the corrugation gradually extends. This theory will possibly partly account for the non-appearance of corrugations on heavy railways. In this case the weight of the train would be sufficient to roll the rail throughout its whole length, especially as the whole of the wheels under the carriages are simply acting as rollers.—Lond. *Electrician,* Oct. 4.

Three-Phase Locomotives.—G. JACOBY.—With respect to the locomotives in the Simplon Tunnel, the author discusses in a simple way the general principles of speed control by means of changing the number of poles.—*Elek. Kraftbetr. u. Bahnen,* Sept. 14.

Single-Phase Traction.—H. M. HOBART.—An illustrated description of the Heyland "cascade single-phase railway system," which was recently described in the Digest.—Lond. *Elec. Eng'ing,* Oct. 3.

Installations, Systems and Appliances.

Electric Installation of Department Store.—R. ZAUDY.—A fully illustrated description of the electric installation of a new department store in the western part of Berlin, which consumes per year about 1,000,000 kw-hours. The number of carbon-filament and metallic-filament lamps is 5200, the number of Nernst lamps 2925, the number of arc lamps 635. There are also in use 59 motors having a total rating of 654 horse-power. On account of lack of space it was impossible to erect an isolated plant, and the energy is bought from the electricity works of Charlottenburg, the motors being directly connected to the supply network. On the other hand, in order to get an acceptable tariff from the station, it was necessary to install storage batteries for lighting in the evening, and for this reason direct current had to be chosen. The three-phase currents supplied from the central station are converted into direct current by three motor-generators, the direct-current machines of which have ratings of 300, 300 and 165 kilowatts, respectively. These motor-generators change the 3000-volt, three-phase current into direct current of 25 volts. Details are given of the construction of the switchboard and the method of wiring. On account of the lack of walls within the building the cables are placed in the floor. For three floors, arc lamps are used, while the floor devoted to ladies' wearing apparel is lighted by Nernst lamps. Emergency lamps are fed by means of a separate network from the storage battery.—*Elek. Zeit.,* Sept. 26.

Hamburg.—An account of the development of the Hamburg Electricity Works. The first plant was erected in 1888, but there are now four different plants, with a total rating of 35,100 horse-power or 22,700 kilowatts. Besides this the storage batteries which are placed in the power stations and in the substations, have an aggregate rating of 8125 kilowatts, so that the total electrical rating of generators and storage batteries is 30,825 kilowatts. For the whole lighting network the three-wire system at 2 x 110 volts is used. With the exception of the network in the St. Pauli district, the neutral conductor is insulated.—*Elek. Kraftbetr. u. Bahnen,* Sept. 4.

Electrophysics and Magnetism.

Radium in Rocks.—A. S. EVE AND D. MCINTOSH.—Strutt has formerly investigated the amount of radium present in specimens of rocks obtained from sources differing widely in geographical distribution and in geological time. As the average result of his investigation there is 1.4×10^{-12} gram of radium in every gram of earth. From this it follows that near the earth's surface there is about 28 times as much radium present as will account for the existing temperature gradient within the earth. Since, however, Strutt did not select a single specimen for investigation from America, the present authors have determined the amount of radium present in typical rocks in the immediate neighborhood of Montreal and have found that the amount of the content of radium is of the same order of magnitude as that found by Strutt. Three explanations may be offered. Either the interior of the earth is different in constitution from the earth's crust, or the disintegration of radium is retarded or stopped under the extreme pressure in the earth's interior, or radium may have reached the earth from external sources.—*Phil. Mag.,* August.

A New Radioactive Element.—B. B. BOLTWOOD.—A note pointing out that strong evidence has been obtained of the existence in uranium minerals of a new radioactive element, which emits both alpha and beta radiations, which produces no emanation and which resembles thorium in its chemical properties. It is without doubt a disintegration product of uranium, and is in all probability the immediate parent of radium. The name "ionium" is proposed for this new substance, a name derived from the word "ion." This name is believed to be appropriate because of the ionizing action which it possesses in common with the other elements which emit alpha radiations.—*American Journal of Science,* October.

Rays.—C. D. COOKSEY.—An experimental investigation of corpuscular rays produced in different metals by roentgen rays. Some of his results do not appear to agree well with the explanation suggested by J. J. Thomson, according to which the energy of the corpuscular secondary rays is due to an explosion of the atom and not directly to the energy in the primary rays. The author found, for instance, that the more penetrating primary rays give rise to corpuscles of higher velocity than the softer rays do, while the intensity of the primary rays makes no difference in their velocity.—*American Journal of Science,* October.

The Disappearance of Magnetism.—M. GILDEMEISTER.—When iron is placed in a magnetic field whose intensity decreases or increases suddenly, it does not immediately assume the corresponding magnetic state, but only after a few minutes. The change occurring seems to consist of two parts, one of which takes place very rapidly, and the other slowly, with a pause between them. The present investigation is concerned with the cessation of magnetization after the removal of the magnetizing field, within 1/2000th second after break. The conclusions from the author's experimental research are as follows: In 1/300,000th second the magnetization falls to less than half its initial value. If only the best results are counted, the time may be reduced to two-thirds or one-half the above. In 1/150,000th second the magnetization falls to less than one-tenth of its initial value, and after 1/150,000th second it has totally disappeared. In the interval between 1/50,000th and 1/2000th second the magnetization does not fall perceptibly. The slow demagnetization evidently does not set in until 1/2000th second has been exceeded.—Lond. *Electrician,* Sept. 27.

Magneto-Optics.—J. BECQUEREL.—A long paper in which the author first describes experiments on magneto-optical phenomena in crystals. Xenotim and tysonit crystals were experimented with, and the author investigated the propagation of light in directions perpendicular to and parallel with the lines of magnetic flux, and also magnetic rotation polarization. In the second part of his paper he modifies Voigt's theory to explain his observations.—*Phys. Zeit.,* Oct. 1.

Units, Measurements and Instruments.

Measuring Electrolytic Resistance.—W. S. FRANKLIN AND L. A. FREUDENBERGER.—Since in determining the conductivity of electrolytes it is important to eliminate the influence of electrodes, the authors have developed a method in which no electrodes are used at all. The principle may be best seen from their first arangement, which is shown in Fig. 2. The two primary coils, P and P^1, are connected in series across 110 volts, 133-cycle mains; producing, with open secondaries, a magnetic flux in the transformer, as shown by the dotted line. The reluctances of the various legs of the transformer are adjusted so that no flux passes through the test coil, M, which is connected to a telephone receiver or alternating-current galvanometer. If now a load is thrown on the transformer by filling the glass vessel with an electrolyte, the balance of m. m. f. is disturbed, some flux crosses through the test coil, M,

producing sound in the telephone receiver. If the other secondary coil is now closed through an adjustable resistance, R_2, a balance of m. m. f. may again be obtained, and no sound heard in the telephone receiver; then R_2 is equal to the resistance of the electrolyte in the glass vessel. This arrangement and the second one described by the authors were not sensitive and finally the arrangement shown in Fig. 3 was used for the actual tests. It represents a Wheatstone bridge in which the electrolyte is connected electromagnetically to one of the arms of the bridge. A slide wire, AB, consisting of 120 ft. of No. 16 B. & S. German silver wire, is wound back and forth on a flat wood surface of convenient size. With secondaries open-circuited the slider, P, is adjusted for zero galvanometer deflection. With the galvanometer used (20 ohms) and a sensibility of 10^{-6} amperes per cm of scale deflection, a movement of P of 1/16 in. in the 120 ft. of slide wire caused a galvanometer deflection of 10 cm (scale divisions.) With a telephone receiver the balance point on the slide wire could only be located within 6 ins. The secondary coil actually used consisted of nine turns (instead of one turn) so that the resistance (R_2) necessary to balance the electrolyte of one turn must be divided by 81 (the square of the ratio of turns) to obtain the actual resistance of the electrolyte contained in the glass vessel. The slider P being set so as to give zero galvanometer deflection, 10,000 ohms (R_2) produced a deflection of 2 cm (scale divisions). This method was applied to the determination of the conductivity of various salt solutions, and in all cases a close agreement within experimental error was found between the results of this electrodeless ring method and the results of Kohlrausch and Holborn.—*Physical Review,* October.

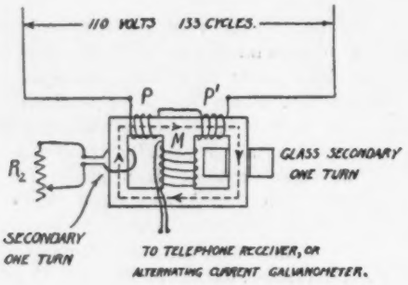


FIG. 2.—MEASURING ELECTROLYTIC RESISTANCES.

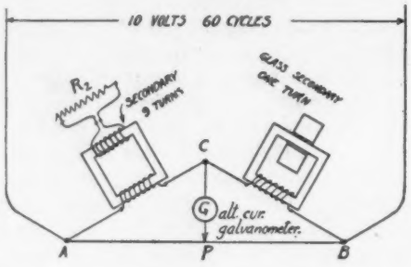


FIG. 3.—MEASURING RESISTANCE OF ELECTROLYTE.

Condensers.—F. W. Grover.—A long paper on the simultaneous measurement of the capacity and power-factor of condensers. Four bridge methods (one of them due to Wien) for simultaneously obtaining the ratio of two capacities and the difference of their power factors are described, and the equations for calculating these quantities from the observations are derived. Various sources of error and methods of eliminating them are discussed. By the use of an auxiliary condenser, two condensers may be compared by substitution. This procedure has the advantage that the electrostatic effects are eliminated, and only the relative values of the resistances and inductances of the bridge arms need be accurately determined. These four methods are compared with one another, and are shown to give results in good agreement. When used as substitution methods, the capacity ratios of condensers of 0.1 mf and greater may be measured to a few parts in 100,000 or better, and a phrase difference of only a few seconds of arc, due to a difference in the absorption, may be detected with certainty. The small temperature coefficients of good mica condensers may readily be determined with accuracy. By the use of a variable air condenser, reliable comparisons of the capacities and power factors of condensers of 0.001 mf or less, such as short lengths of cable, may be easily made. Methods are given by which the power factor of the condensers to be used as standards may be measured. The Bureau of Standards makes such determinations when requested. Examples are given to show what values of the power factor may be expected in condensers by leading manufacturers. A knowledge of the power factor of a condenser gives reliable information as to the order of magnitude of its absorption effects. The determination of the power factor is the best single test of the quality of a condenser which can be made.—*Bull. Bureau of Standards,* Vol. III, No. 3, August.

Coefficient of Self-Induction.—G. Athanasiadis.—An illustrated note on the use of the differential electrometer for determining the coefficient of self-induction.—*Phys. Zeit.,* Sept. 15.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—C. R. Fountain and F. C. Blake.—An account of an experimental investigation of the relative amounts of energy radiated in various directions about a Righi vibrator. In computing the total energy in the field about a Righi vibrator it is necessary to consider the radial component of the electric force as well as the transverse components of the electric and magnetic forces. The electromagnetic waves spread out from the spark-gap in such a manner that the energy at any point is approximately proportional to the square of the cosine of the angle between the radius vector and the equatorial plane and inversely proportional to the square of the distance from the spark-gap. The energy due to the radial component of the electric force varies approximately as the square of the sine of the angle between the radius vector and the equatorial plane and inversely as the fourth power of the distance from the spark-gap. In order to receive the maximum energy the thermal element of the Klemencic type should everywhere be perpendicular to the radius vector except near the poles, where it should be parallel to the radius vector. The thermal element used in these experiments when placed in the equatorial plane with its axis parallel to the direction of propagation of the electromagnetic waves absorbs more than 14 per cent as much energy as when it is in the resonating position. This type of receiver absorbs a small amount of energy when it is on the polar axis and perpendicular to it, and, therefore, perpendicular to the radius vector. Two such receivers in the same field greatly influence each other. A Righi vibrator does not continue to give out wave-trains of the same strength or character as shown by its "deterioration" with use. The waves from a Righi vibrator appear to become less plane polarized as they proceed from the vibrator. A theory based upon the assumption that the waves from a Righi vibrator are identical with those from a vibrating "electric doublet" and also that the thermal element of the Klemencic type acts as a "point receiver" holds with a fair degree of accuracy up to within three-quarters λ for the vibrator.—*Physical Review,* October.

Electric Oscillations.—K. E. F. Schmidt.—In laboratory experiments on electric oscillations produced by the spark method he found that when the spark was produced in air the results were not uniform from day to day, but that when the sparks were produced in an atmosphere of hydrogen, very uniform and constant results could be obtained. When he tried, however, to use sparks through hydrogen for the purposes of wire-

less telegraphy he found that the results were by no means satisfactory. With the hydrogen spark-gap the oscillations are of much less intensity and considerably more damped than with an air-gap. The same issue contains another paper by the author on damping in transmitting and receiving stations for wireless telegraphy. Methods of connection are described which reduce the damping of the oscillations. The author also gives results of measurements which show the great influence of the atmosphere on the propagation of the electric wave. He also shows that the receiving effect is a maximum for earthed systems, and discusses the influence of the position of the earthed wire on the intensity of the received wave. He describes an experiment in which a differential action between the oscillation in a vertical and in a horizontal antenna is obtained.—*Phys. Zeit.,* Oct. 1.

Electric Oscillators.—J. A. Fleming.—A continuation of his serial on the elementary theory of electric oscillators and the production of electric waves thereby. The first part deals with the action of a Hertzian oscillator, and it is shown how to obtain expressions for the electric and magnetic forces at any point in space around it. The second part, in like manner, discusses the closed or magnetic oscillator, and expressions are obtained for the forces and radiative power. In the third part combinations of open and closed oscillators are discussed, and the elementary theory of the bent oscillator, which radiates unsymmetrically, is given. The article is to be continued.—Lond. *Electrician,* Oct. 4.

BOOK REVIEWS.

Hendricks' Commercial Register of the United States for Buyers and Sellers. By Samuel E. Hendricks Company, of New York. Sixteenth edition. 1224 pages. Price, $10.

This directory contains over 350,000 names and addresses, with upwards of 15,000 business classifications. It is perhaps the most complete directory of its kind in existence. The present edition requires 76 pages for its index, which will give some idea of the comprehensiveness of its classifications. The policy of the publishers of this directory is to make no charge for fully classifying a firm's business, and in this way a complete representation is obtained. The electrical headings are particularly complete, and the book will undoubtedly be of great value to any one who has occasion to look up the addresses of manufacturers or to learn who are the manufacturers of different devices.

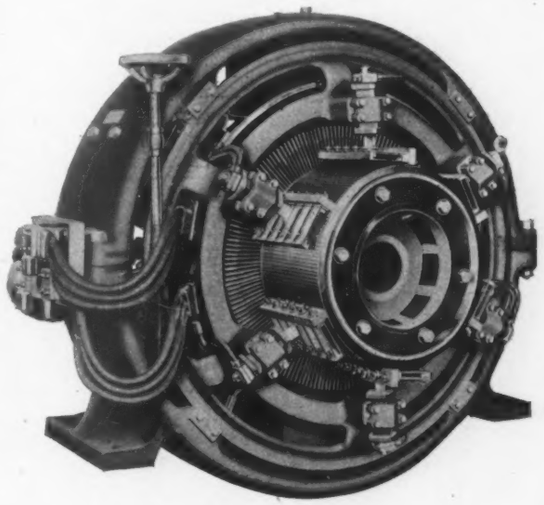
Elements of Electric Traction. For Motormen and Others. By L. W. Gant. New York: D. Van Nostrand Company. 217 pages, 38 illustrations. Price, $2.50.

The author in his preface states that this book is based upon a short series of lectures and practical demonstrations given to a class of motormen and others at the Leeds Institute Technical School, and is put forth to serve as an introduction to the more advanced works on electric traction, and to supplement the information given in various handbooks for motormen and others. The first five chapters deal with the elements of electricity and magnetism, and the principles of the dynamo and direct-current motor. Chapters 5 and 6 are, respectively, on power and power measurement, and the mechanics of traction, and Chapters 8 and 9 on the characteristic properties of the direct-current motor and its application to traction. The book ends with Chapter 10, devoted wholly to brakes. Examples have been added to some of the chapters, showing the numerical application of the formulas and practical principles developed. We fear that the book is far beyond the mental grasp of motormen, excepting the rare ones who wish to acquire knowledge which will enable him to pass from the car platform to the car house or repair shop. On the other hand, the book will be found of much value by all men employed in technical work on electric railway systems, and also by the student as a preliminary of the reading of the literature of electric traction engineering.

New Type of Direct-Current Generator.

To meet the increasing demands for direct-current generators direct connected to the prime mover, the Sprague Electric Company, 527 West Thirty-Fourth Street, New York City, has recently brought out a new line of generators, ranging in rating from 25-kw upward. A distinctive feature in the design of these generators is the use of soft steel instead of cast iron for the magnet yoke. Their compactness, shown in the accompanying illustration, is specially advantageous in modern central stations, hotels, office buildings and apartment houses where economy of floor space is important. Low armature reaction and low armature resistance are other special features of the generators, making them, it is said, highly efficient, of excellent regulation, and of good commutation on overloads without shifting the brushes. The machines are compound-wound and have laminated poles. This latter feature, it is claimed, permits both elevators and lamps to be supplied from the same generator without troublesome blinking of the lamps.

The armature core is also laminated. The punchings are made of sheet steel having a low hysteresis loss and are clamped



DIRECT-CURRENT GENERATOR.

between cast-iron end plates which have a projecting flange for supporting the end winding, on a substantial cast-iron spider to which they are securely keyed. Space plates and a large opening through the center of the core permit of ample ventilation. The copper armature conductors have a rectangular section and are shaped on a former. On machines of standard speed they are retained in the slots by heavy bands over the end windings, but treated wooden wedges are also used. The commutator is insulated throughout with micanite and clamped by a cast-steel ring to a cast-iron shell rigidly supported by the armature spider. The brush holders, brushes, rocker arm and hand wheel are of the simple and substantial construction used for years on Sprague generators.

Seventy-Two-Ton Electric Locomotive.

One of the most interesting exhibits at the Atlantic City convention of the American Street & Interurban Railway Association was the 15-cycle, single-phase locomotive built by the Westinghouse Electric & Manufacturing Company, and shown on the switch on Virginia Avenue, near the Board Walk This locomotive was built for demonstration purposes under an agreement with the Pennsylvania Railroad, as described on page 117 of our issue for July 20, 1907. We are able to give below an outline of certain details not covered in our earlier note.

The locomotive shown is of the articulated type, and it consists of two separate halves, each of which, however, is complete

in itself. Each half has a maximum draw-bar pull of 20,000 lbs. Only one of these halves has been built and that one formed the exhibit at Atlantic City and is illustrated in the accompanying engraving.

The underframing of the locomotive is of the Atlantic type, of cast steel, with cast steel end sills and cross girders, and provides for two driving axles with wheels 72 ins. in diameter and a pilot truck with wheels 36 ins. in diameter. The total wheel base of the half-locomotive illustrated is 20 ft. 7 ins.; the rigid wheel base is 7 ft. 6 ins., and the wheel base of the pony truck is 6 ft. 2 ins. The motors are mounted on the driving axles with the same sort of suspension as employed in the New Haven locomotives but are more powerful, having a one-hour rating of 500 horse-power, with a maximum of 800 horse-power and a continuous rating of 375 horse-power. This gives a tractive effort for total locomotive, maximum, 40,000 lbs., or on the one-hour rating of 14,700 lbs., or a continuous draw-bar pull of 9,200 lbs.

An inspection of the interior of the locomotive shows great simplicity as compared with the New Haven locomotive, owing principally to the fact that no provision is made for direct-current operation. Moreover, the main transformer, the most bulky of all the auxiliaries, is carried under the floor on the bolster over the pony truck, where it is entirely out of the way. The rest of the auxiliaries are mounted on a raised platform extending down the center of the car with passage ways on each side, and at this height are capable of easy inspection. The end of this raised platform nearest the motorman's position is given up to the unit switches, 15 in number, for the transformer taps, and directly in the rear of these switches are the three compensating coils used in passing from one tap to another. These are followed by the electric blower with air ducts leading to the transformer and motor casings. Directly in the rear of the blower are the air reservoir and reverser, the latter provided with four pneumatic switches. These switches are of the standard pneumatic type but larger than those used in ordinary car control. The rest of the apparatus on the platform consists of a pneumatic track-sander, a compressor motor and a 20-volt storage battery with a small motor-generator for charging.

SEVENTY-TWO-TON SINGLE-PHASE LOCOMOTIVE.

The following are some general data of the complete locomotive:

Total weight, tons	140
Weight on each driver, pounds	50,000
Weight on each of the two pony trucks, pounds	40,000
Weight of each motor, pounds	19,500
Length over all (half locomotive)	31 ft.
Height of locomotive	13 ft. 4 ins.
Width of locomotive	10 ft.

The center of gravity of the locomotive is about 55 ins. above the heads of the rails.

The locomotive is designed to operate with an e. m. f. of 11,000 volts on the trolley wire and 275 on each motor.

A sign mounted on the locomotive shown at Atlantic City stated that during the past two and a half years 630 Westinghouse single-phase locomotives had been shipped to 18 railway companies in America and Europe. These motors range from 40 to 250 nominal horse-power, and make a total of 79,380 nominal horse-power. There are now on order 310 Westinghouse single-phase railway motors for shipment to 11 different railway companies, totalling 34,135 nominal horse-power. This makes a grand total of 940 Westinghouse single-phase motors delivered to or on order for 25 different railway companies, and aggregating 113,515 nominal horse-power.

Soft-Drawn Steel Instrument Cases.

The American Instrument Company, Newark, N. J., has developed an effective form of magnetic-shielding case for its electrical instruments. The case is made of soft-drawn sheet steel of uniform texture and thickness. There are no hard spots in the material, and no sharp corners, and it is stated that the case cannot become permanently magnetized.

The magnitude of the influence of a strong external field upon the readings of a permanent-magnet moving-coil instrument, when housed in the type of case described above,

FIG. 1.—CORRECT INDICATION.

may be learned by comparing Fig. 1 with Fig. 2. Fig. 1 shows an instrument in which the current had the value indicated by the pointer. While the current was maintained constant a magnet such as is used inside of the instrument was placed on the case directly over the poles of the inside magnet. A

FIG. 2.—INCORRECT INDICATION.

very slight change in indication of the instrument took place, as noted in Fig. 2. When the position of the outside magnet was reversed so as to change the polarity, the effect upon the indication of the instrument was even less than shown. The tests indicate the efficacy of the case for use in close proximity to cables in which large values of currents exist.

The "American" instruments are being placed on the market by James G. Biddle, 1114 Chestnut Street, Philadelphia, who is general sales agent for the manufacturer.

Large Gas-Engine Generating Station.

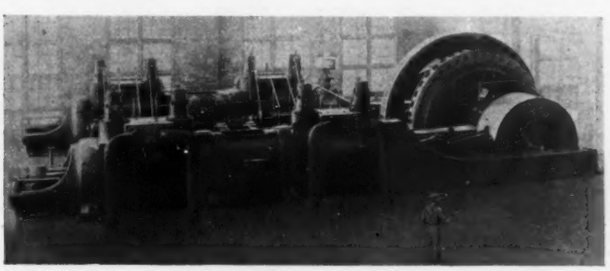
On account of the excellent results obtained from gas engines the Indiana Steel Company has adopted this type of prime mover for its mills at Gary, where gas engines are to be used exclusively.

The entire electric generating equipment of this plant is being supplied by Allis-Chalmers Company. The portion now under contract consists of 17 4000-hp gas engines, 15 of which are direct connected to 25-cycle, three-phase alternators, which will operate in parallel and supply energy to more distant portions of the mill; two serve for driving direct-current generators supplying energy for portions of the plant immediately adjacent to the generating station.

The Allis-Chalmers Company is also building eight blowing engines with the same sized gas cylinders as the electrical units for the same plant, making 25 engines, or a total of 100,000 hp in gas engines which the company is supplying for this power house alone.

It will require approximately 1000 carloads to complete the shipment of these engines. The electrical power house, in which will be installed the 17 electrical units, is 1000 ft. long and 105 ft. wide. It will be one of the largest power houses in the world, and the electrical generating station at this plant alone will be twice as large as any previous gas-engine installation either at home or abroad.

The power house containing the blowing-engine units is of the same width as the electrical house and is 600 ft. long.

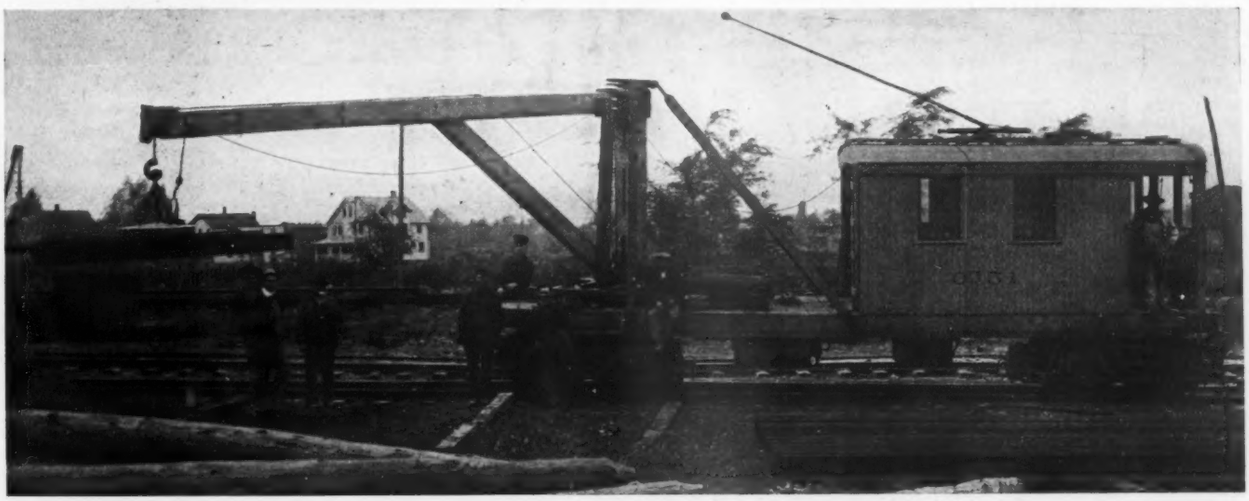


GAS ENGINE GENERATING UNIT.

These figures give some idea of the magnitude of this gas-engine installation and of the confidence which the designers of this great plant repose in the Allis-Chalmers gas engine as a prime mover. The realization of this is, in large measure, responsible for the interest in gas engines shown by power users in general. With gases being wasted which were suitable for use in gas engines, it was but natural that the iron and steel industries should be the first to adopt the use of gas engines on a large scale. The saving in the first cost of fuel, however, is to a certain extent offset by the interest charges on the cleaning apparatus which is necessary in order to remove from blast furnace gas the abrasive dust with which it is charged; this extensive cleaning apparatus, however, is not necessary where producer gas is used. It is manifest that the gas engine using producer gas is now to take its place permanently as a prime mover in situations where the cost of fuel makes economy in this direction especially desirable.

Lifting Magnets.

Two different forms of lifting magnets for lifting purposes have recently been placed on the market by the Cleveland Armature Works, Cleveland, Ohio. The magnets are designated as the "inter-pole bell" and the "inter-pole flat." The former consists of heavily annealed steel casting which, as the name implies, is bell-shaped. There are two magnetizing coils, so placed in relation to each other that they form a solenoid in two steps separated by an iron ring and the so-called inter-pole. The outer shell of the casting extends below the under face of the outside coil, and a heavy shield of non-magnetic material bridges from pole to pole to protect the magnetizing coil. Various sizes of the bell magnets are made. The largest size is 52 ins. in diameter and weighs 4900 lbs.; it requires 4400 watts. This magnet will lift from 1000 to 1350 lbs. of sand-cast pig iron or about 1200 lbs. of plate scrap. It is able to lift 15 tons in a single piece.



LIFTING MAGNET FOR ELECTRIC RAILWAY CONSTRUCTION WORK.

The inter-pole flat magnets are designed on the same principle as are the bell magnets, but they are intended especially for handling large pieces of material, such as heavy castings, billets, or corded pig iron, etc. The accompanying illustration shows such a magnet in use on a derrick car in electric railway construction work.

Speedy Erection of Turbo-Generators.

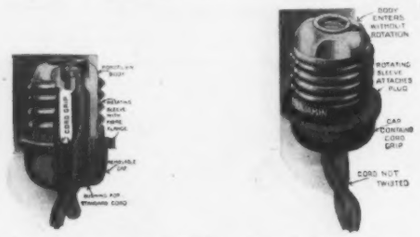
What is probably a record for the furnishing and installing of steam turbines was made by Allis-Chalmers Company in connection with two 1000-kw steam turbines and accessories which that company built for the South Works of the Illinois Steel Company, at South Chicago, Ill. The contract was signed on May 13, 1907; shipment commenced from the factory on May 25, and finished on May 31; the erection of both units was completed July 16, and commercial load was put on the machines July 22. Since that time they have operated almost continuously, carrying loads up to 1500 kilowatts each; that is,

loads 50 per cent above their rated capacity. At one stretch the turbines ran over three weeks day and night without being stopped. The turbines are installed in a temporary wooden building and, as no crane or the usual facilities were available during the erection, the record given above is remarkable. Since starting the turbines have given no trouble whatsoever, and the manufacturer's engineers left them in charge of the Illinois Steel Company's operators within a few days after load was first carried.

The installation consists of two units, each comprising a 1000-kw steam turbine coupled to a 1000-kw, 25 cycle, three-phase, 2300-volt turbo-alternator, together with necessary surface condensing apparatus, pipe connections and switchboard. The speed of the turbines is 1500 r. p. m.; each is provided with a direct-connected exciter. The steam turbine is of the horizontal, full annular flow, reaction type, and is provided with a number of special features, such as improved methods of holding and protecting the blades, improved balance pistons, etc.

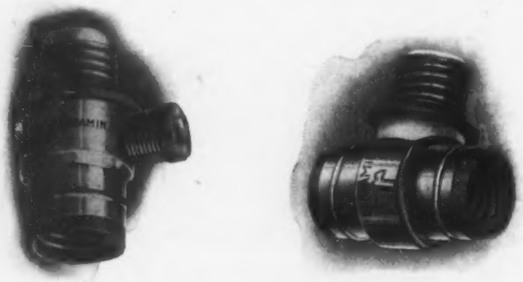
Some New Electric Lighting Specialties.

The Benjamin Electric Manufacturing Company, of Chicago, is bringing out this fall a number of useful socket and receptacle devices. Figs. 1 and 2 show a very neat swivel attachment plug which is much smaller and more compact, as well as in some ways more substantial than the attachment



FIGS. 1 AND 2.—SWIVEL ATTACHMENT PLUG.

plugs heretofore offered. The plug has a porcelain body with a rotating sleeve, in which sleeve the screw thread is stamped. This rotating sleeve is provided with a fibre flange with a milled edge for the fingers to take hold of when screwing it into a lamp socket. The binding screws and terminals are fastened on the porcelain inside this screw sleeve. The plug is provided with a cap in which either standard or reinforced cord can be used. The wire passes through a soft rubber ring in the cap, and when the cap is screwed down tight it presses this ring so as to form a cord grip. The plug has very little



FIGS. 3 AND 4.—CURRENT TAP AND TWIN ATTACHMENT PLUG.

porcelain exposed. Parts which would naturally receive blows are of brass, fiber and composition. This, together with the small size of plug, renders it not as liable to injury as many other plugs.

Fig. 3 shows a new current tap, by means of which an extension cord can be led off from the socket in addition to the regular lamp at that socket. This has a threaded sleeve which turns in the same way as that of the extension plug, so that the whole device does not have to be rotated in screwing it into a socket. One of the improvements in this current tap over others previously brought out is that it permits the use of any standard shade holder, so that the proper reflector can be used over the lamp if desired. The omission of this important feature has made many current taps almost worthless for a large percentage of the locations where they might be used. This current tap is also made with a series connection, so that the device tapped off may be in series with the lamp in the socket.

Fig. 4 shows a new twin attachment plug, whereby two receptacles can be obtained from one socket. It is not necessary to turn this device to screw it into the socket, and it will remain at any angle at which it is placed after it is screwed in. It is believed that this will prove useful in such locations as show windows, where a merchant already has border lights which he would like to change to lamps carrying parabolic half reflectors. This twin attachment plug can also be supplied for lamps to be operated in series, so that two 110-volt tantalum or other high-efficiency lamps can be operated on a 220-volt cir-

FIG. 5.—TWIN RECEPTACLE.

FIG. 6.—RECEPTACLE.

FIG. 7.—PORTABLE HAND-LAMP HOLDER.

cuit. Fig. 5 shows the twin receptacle modified so as to afford one receptacle at right angles to the socket in which it is screwed.

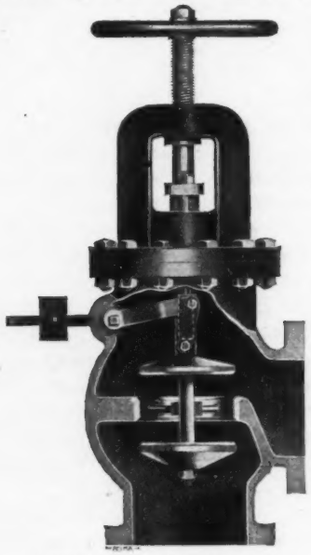
Fig. 6 is a receptacle which, besides taking the place of the ordinary wall receptacle, also permits the use of a Benjamin shade holder. This makes a neater and stronger device for use with a shade holder than the standard wall socket which it would otherwise be necessary to employ if a shade holder were needed. This receptacle in its improved form has its shell held in place by screws and not by the porcelain bushing, as in the older forms.

Fig. 7 is a portable hand-lamp holder and guard made entirely of insulating material. This is intended especially for the use of wiremen working around switchboards in power stations and for pitmen in electric railway shops. The guard parts are placed edgewise radially to the lamp. The guard is of hard fiber and the handle of composition.

Automatic Cut-Off Valve.

There are many devices on the market which prevent steam from flowing back into the boiler, but which make no provision against accident to the steam piping; the steam escaping in the latter case until the boiler is emptied. The valve shown herewith is claimed to act not only as a non-return valve, but as an automatic cut-off valve as well. It does not depend upon difference of pressure for its action, but upon the flow of steam through it. The operation of the valve may be followed by the aid of the illustration. The upper valve normally rests upon the seat and prevents steam from the main entering the boiler. When the steam pressure in the boiler exceeds that in the main, the valve lifts and steam passes from the boiler to the main. The valve is nearly counterbalanced by a weight, the leverage being adjustable to different rates of flow. With the normal flow of steam, the discs are in the mid-

position shown. In case of emergency, such as a break in the line, the excessive rush of steam carries the lower valve up against its seat and steam is shut off. The upper valve, in case of a reverse flow, drops to its seat with a similar effect. The balancing lever is provided with light, adjustable springs,

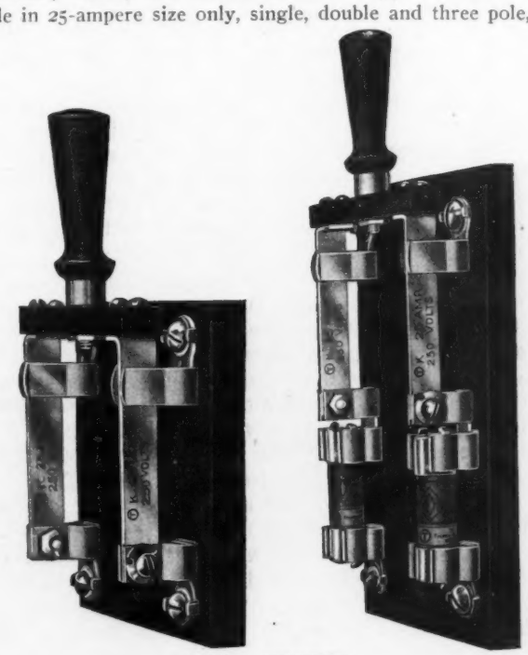


AUTOMATIC CUT-OFF VALVE.

which are said to prevent the chattering or closing of the valve under ordinary conditions, but which are not strong enough to prevent closure in case of accident, although permitting momentary rushes of steam. The maker of the valve is the Lagonda Manufacturing Company, Springfield, Ohio.

New Knife Switch.

The accompanying cuts show a new knife switch recently put out by the Trumbull Electric Manufacturing Company, of Plainville, Conn., and known as the "Kappa" switch. It is made in 25-ampere size only, single, double and three pole, un-



KNIFE SWITCHES.

fused and fused, for both enclosed and open link fuses. The switch, which has been approved by the underwriters, is designed for light work and is intended to meet the demands for an inexpensive switch, which is at the same time thoroughly reliable.

Exhibits at the Atlantic City Convention of the American Street & Interurban Railway Association.

The exhibits on the Steel Pier, at Atlantic City, during the convention of the American Street and Interurban Railway Association eclipsed any heretofore made under the auspices of the American Street and Interurban Railway Manufacturers' Association. At the meeting of the Manufacturers' Association on Thursday afternoon, Oct. 17, the report of the president, Mr. James H. McGraw, showed that since the matter of exhibits was taken up by that association, the arrangement had proved more advantageous than heretofore. The report of the treasurer revealed the fact that there were now 315 members in the association, 210 of whom made exhibits at Atlantic City. Space limitations preclude our describing all of these exhibits, but the accompanying notes, although brief, may convey an idea of their extent and variety.

Dossert & Company, of New York, exhibited their line of solderless connections and couplings.

The Sherwin-Williams Company, of Cleveland, Ohio, displayed samples of its various paint and varnish products.

The Heany Fireproof Wire Company, York, Pa., had specimens of its fireproof tape, wire and other materials on exhibition.

The A. & J. M. Anderson Company, of Boston, presented many specimens of its Aetna insulation, together with a line of switches, etc.

The D. & W. Fuse Company, Providence, R. I., showed an interesting line of fuses and other of its specialties, including deltabeston wire.

The Van Dorn Electric & Manufacturing Company, Cleveland, Ohio, showed armature and field coils, commutators, pinions, drills, etc.

A. Grothwell, of New York, had several cans of Mogul paints and varnishes on exhibition, together with specimens of work done by them.

The Ridgway Dynamo & Engine Company, of Ridgway, Pa., while making no exhibit, distributed literature relating to its engines and dynamos.

The Gould Storage Battery Company, Depew, N. Y., made a telling display of storage batteries and elements, together with photographs of installations.

The Chicago Pneumatic Tool Company, of Chicago, showed a full line of its pneumatic and electric tools, many of which were shown in operation.

The Union Electric Company, of Pittsburg, had several boards with samples of bonds, headlights, fuses, lamps, pinions and trolley stands on exhibition.

The Ball & Wood Company, Elizabeth, N. J., had some interesting photographs of recent installations to show, as well as specimens of its piping work.

The Buckeye Engine Company, of Salem, Ohio, exhibited a collection of photographs of its engines, and gave away flowers and buckeyes as souvenirs.

The France Packing Company, of Philadelphia, displayed metallic and fibrous packing, such as is used in many of the largest power houses in the country.

The Western Electric Company had headquarters at the Hotel Islesworth, and made an exhibit on the Steel Pier covering a full line of electric railway supplies.

The Rail Joint Company, of New York, displayed its "base supporting" type joints, known to the trade as the "continuous," the "Weber," and the "Wolhaupter" rail joints.

The American Sewer Pipe Company, of Pittsburg, Pa., exhibited a number of vitrified clay conduits with single and multiple ducts for underground electrical work.

J. G. White & Company, Inc., of New York, had several representatives from the New York office present, as well as a number from the company's operating properties.

The National Carbon Company, Cleveland, Ohio, exhibited carbon products, including brushes for motors and dynamos, dry batteries and arc carbons.

The Sterling Varnish Company and Pittsburg Insulating Company, allied companies of Pittsburg, made a joint exhibit of varnishes, protective coatings and insulated linens.

The Locke Insulator Manufacturing Company, of Victor, N. Y., had a number of its new 100,000-volt suspended type insulators on exhibition. These attracted no little attention.

The Southern Exchange Company, of New York, had on exhibition samples of long-leaf pine octagonal poles, Southern white cedar round poles, and Georgia long-leaf pins and cross-arms.

The George W. Lord Company, of Philadelphia, maker of boiler water purifying compound, was on hand to welcome its guests and persons interested in water purification for boiler feed purposes.

The Standard Paint Company, of New York, had on exhibition a complete line of varnishes, insulating tape and preservative paints. Apparatus was shown treated with the company's products.

The Peerless Rubber Manufacturing Company, of New York, manufacturer of the celebrated Rainbow packing, exhibited a full line of mechanical rubber goods, including hose, packing, step treads, etc.

The Yale & Towne Manufacturing Company, New York, made a fine exhibit of chain blocks, hoists, overhead trolleys, a model of a jit crane, etc. The hoists shown were both motor-driven and hand-operated.

The American Blower Company, Detroit, Mich., included in its exhibit an 80-in. steel plate fan, a pressure and a volume blower, a bank of heating coils, a model dry kiln, and a small direct-connected generator.

The Electric Service Supplies Company, of Philadelphia, Chicago, etc., entertained its guests in a tastefully arranged parlor and exhibited samples of various lines handled by the company, too numerous to mention.

The Holophane Company, of New York, showed a number of its scientific and prismatic reflectors for car lighting. These included reflectors for general car illumination and also reflectors for individual lamps over seats.

The American Ferrofix Brazing Company, of Philadelphia, showed a line of brazing torches and miscellaneous apparatus for performing the work of mending broken and cracked machinery by the Ferrofix process.

The Dearborn Drug & Chemical Company, of New York, showed different boiler compounds, as well as tubes betraying pitting and corrosion due to impure water. Oils and greases for elevators also formed part of the exhibit.

The Franklin Electric Manufacturing Company, of Hartford, Conn., demonstrated the qualities of its "Novi" street railway lamps by means of a vibrating machine. Various forms of high-efficiency lamps were also a feature.

The Stromberg-Carlson Company, Rochester, N. Y., had as the chief feature of its exhibit a telephone dispatching system connected up for service. Portable telephones and several telephones of standard type were shown in addition.

The Massachusetts Chemical Company, of Walpole, Mass., manufacturer of friction tape and insulating compounds, had a full line of samples displayed, together with descriptive literature and souvenirs for distribution.

The Allis-Chalmers Company displayed an extensive line of air-brake apparatus, together with photographs of turbines, reciprocating engines, rotaries, motors, etc. An interesting feature was a new emergency valve for air-brake equipments.

The Lord Electric Company, of New York and Boston, exhibited a rotating-type lightning arrester and abnormal potential discharger. The Shaw lightning arrester, soldered rail bonds and an automatic car seat heat deflector were also shown.

The Samson Cordage Works, of Boston, Mass., showed samples of its products. Prominent among these was the mahogany wire center cord, which is made up with a galvanized steel wire cable center, ensuring durability and absence of stretching.

The Standard Varnish Works, New York, had samples of solid compounds for use in connection with vacuum drying and impregnating apparatus on exhibition. Among the compounds shown was "Voltalac," which is well known to the electrical fraternity.

The Joseph Dixon Crucible Company, of Jersey City, N. J., had a rather unique display in the shape of an old horse car bearing Dixon signs. The various graphite products of the company were shown and pencils, dice pails and aluminum trinkets were distributed as souvenirs.

The Crocker-Wheeler Company, of Ampere, N. J., showed photographs of installations containing its well known generators for railway service, as well as photographs of the plant of the California Gas & Electric Corporation, where three 4000-kw alternators driven by gas engines are installed.

The Blake Signal & Manufacturing Company, of Boston, Mass., had a complete working exhibit of standard signal apparatus, together with a competent train dispatcher for explaining its operation. Various types of railway telephones and standard blanks, etc., for telephone train dispatching were shown.

The H. W. Johns-Manville Company, of New York, had an attractive exhibit. Victor combination meters, overhead line material, "Noark" fuse devices, asbestos lumber, molded mica sockets, arc lamp hangers, high-tension insulators, rail bonds, friction tape, doors for transformer stations, controller linings, etc., were all shown to advantage.

The Ohio Brass Company, Mansfield, Ohio, occupied a large space at the exhibition. The various sales divisions under which the extensive products of the company are classified were well represented, including the high-tension division, rail bond and third-rail insulator division, overhead line material division, car equipment division, and mining division.

The Electric Storage Battery Company, Philadelphia, had an interesting exhibit. Among the products shown were one element of type 71-R in a containing tank large enough to hold 83 plates of this type; a 12-pole carbon regulator, recording hydrometer, automatic cell filler and compensating hydrometer, and examples of positive and negative plates of all types.

The McGraw Publishing Company occupied a prominent position facing the entrance to the pier and directly opposite the registration booths. Here copies of the souvenir issue of the *Street Railway Journal* were distributed, as well as copies of the Electrical World, *The Engineering Record,* and the "Directory of Electric Railway Material." Engineering books covering every branch of science were also shown.

The General Electric Company's exhibit occupied one of the largest spaces on the pier. The parts of a 100-kw, 12,000-volt Curtis turbo-generator were shown, as well as a complete installation of an emergency straight air-brake outfit. For the first time at any convention a commutating pole motor was shown in operation. A collection of contactors and similar devices used in railway equipment were exhibited, together with a new controller designed for four 500-volt, 50-hp motors. Arc lamps for railway service, incandescent lamps, bonds, line material, etc., were displayed to advantage. The whole space was arranged to facilitate easy inspection.

The Westinghouse Electric & Manufacturing Company showed a large single-phase electric locomotive described elsewhere. The control equipment was also exhibited, showing the method by which the voltage is reduced. The catenary line construction used on single-phase roads was also shown, as well as the pantograph trolley. There were also on exhibition direct-current line material, full repair parts for motors, several direct-current railway motors, two interpole railway motors, arc lamps, etc. In conjunction with the Westinghouse Machine Company, a 500-kw steam-turbine generator set was displayed for close inspection.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The favorable weather stimulated trade and collections showed improvement. While reports were almost unanimous regarding the satisfactory volume of retail distributions of seasonable goods, in other sections of commercial and industrial activity there was some irregularity, attributed in most cases to high rates for money, which induces conservatism in preparations for the future. The crop news of the week was not favorable. Killing frosts were reported to have destroyed the probability of any important quantity of top crop in the northern half of the cotton belt, while the effect of frosts at the north will be to increase the quantity of soft corn beyond that of recent years. The car-shortage trouble is reported still affecting the movement of grain, coal and lumber, but gross receipts tend to become more moderate, while net returns show a swallowing up of earlier gains in increased operating expenses. The features of the foreign trade returns for September are the shrinkage shown in the imports of merchandise as compared with the preceding month of August and the decrease shown in leading lines of export (such as breadstuffs, cotton and provisions) and in all exports as compared with September a year ago. Thus imports in September were 15.5 per cent smaller than those of August, though 3.6 per cent larger than in September a year ago, while leading exports fell 6 per cent behind September a year ago, and all exports were 2.2 per cent smaller. Business in iron and steel was very quiet, but prices on the whole are well maintained at recent declines. The industry, however, is very active in general on old orders. Business in steel rails was light and demand for structural steel small. Copper was again weaker and more competition for small orders developed. Lake copper for future delivery is quoted on the basis of 12¾ to 13 cents per pound, while the figures on electrolytic range from 12¼ to 12½ cents. Outputs have fallen off considerably and the price has been cut in half within the past five or six months, from which two facts some argue that business must soon develop. On the other hand, there are many who look for a lower level than 12 cents.

ORDERS FOR PLANT.—Judge Lacombe, of the U. S. Circuit Court, has issued an order giving the receivers of the Metropolitan Street Railway Company permission to spend $3,000,000 for new cars and other equipment to take the place of that destroyed by fire and needed for increasing business. Although the New York City Railway Company had ordered new cars to take the place of those destroyed, but thirty of them have been delivered up to date. The petitioners are advised, they say, that nine new cars can be purchased, ready for delivery, and eighty additional cars of the closed or winter type contracted for, with deliveries on or about Jan. 15 next. It is also possible, the two receivers state, for 155 additional cars of special type and of large capacity to be bought for delivery from time to time before the close of the year. Properly to operate the system, the receivers also ask permission to replace the destroyed car barns at 146th Street and Lenox Avenue, where repair shops were located. Since the fire the system has been seriously crippled in its operation, it is alleged, because of the lack of these shops.

THE B. F. STURTEVANT COMPANY reports the following sales of electric generating sets by Mr. F. R. Chinnock, of the electrical department of its New York office, Engineering Building, 114 Liberty Street, New York City: Kiernan & Hughes Company, Jersey City, N. J., one 9x8 vertical engine, 30-kw generator; Millard & McLean, New York City, one 4½x4½ vertical engine, 5-kw generator; Henry Steers, Inc., New York City, one 4½x4½ vertical engine, 5-kw generator; two 6x5 vertical engines, 7½-kw generators; Sonora Company, New York City, three 10-hp motors; Washburn Brothers Company, Saugerties, N. Y., 13x12 horizontal engine, 50-kw generator, 20-hp motor; Eberhard Faber Pencil Company, Brooklyn, N. Y., 16x14 horizontal engine, 100-kw generator; Department of Water Supply, Babylon, L. I., 9x8 vertical engine, 40-kw generator; Samuel Smith & Sons Company, Paterson, N. J., 16x14 horizontal engine, 100-kw generator; Isidor Fajans, New York, 9x8 vertical engine, 30-kw generator; Charles Hakemeyer Company, Paterson, N. J., 17½-kw generator, three 5-hp motors.

TELEPHONY IN CHICAGO.—It is stated from Chicago that the Armour interests will develop the telephone possibilities of the Chicago Subway Company themselves, and the plan to lease telephone rights to independent interests has been abandoned.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a violent break in prices, led by the copper shares, and two suspensions of stock exchange houses. A reduction of the Amalgamated Copper Company dividend from an 8 to a 4 per cent basis; a disastrous manipulation of United Copper—a curb stock; increased firmness in money, and apprehensions about the position of speculative institutions, were among the leading unsettling factors. At the same time, the general stock list developed extensive liquidation in all directions, resulting in a general decline, with the lowest quotations for the year in the greater part of the active stocks. United Copper on Tuesday was forced up from 35 to 60, and on the following day it collapsed, falling to 20. On Thursday the stock fell as low as 10, but assurances that the unsoundness of the situation did not extend beyond the clique directly concerned in an attempt to corner United Copper stock, had a steadying effect upon the market, which continued the rest of the week. All of the electric and traction stocks declined with the rest of the list, all falling to the lowest levels for the year, with the exception of Allis-Chalmers common which kept steady at 6½. Following are the highest and lowest quotations of the year for the principal electric stocks, showing the great shrinkage in values:

	High.	Low.
Allis-Chalmers, common	16⅞	4
Allis-Chalmers, preferred	43¾	15
American Telephone & Telegraph	133	100
Brooklyn Rapid Transit	83⅜	37¼
General Electric	163	109⅛
Interborough-Metropolitan	39	7¾
Interborough-Metropolitan, preferred	75½	18
Mackay Company	75¼	53½
Mackay Company, preferred	71	54
Metropolitan Street Railway	107	35
Western Union	84¼	65
Westinghouse	154	108

The week's curb market was attended with heavy liquidation, with suspensions resulting from sensational declines in United Copper and with the sacrifice of many speculative accounts. The trading was the heaviest of the year, being some ten times the volume of the ordinary week. Following are the closing quotations of Oct. 22:

NEW YORK.

	Oct. 15	Oct. 22		Oct. 15	Oct. 22
Allis-Chalmers Co.	6⅛	5½	General Electric	111¾	106
Allis-Chalmers Co. pfd.	16	14½	Hudson River Tel.	—	—
Am. Dist. Tel.	20	—	Interborough Met. com.	8	5¼
American Locomotive	45½	43½	Interborough Met. pfd.	22¾	15⅛
Amer. Locomotive pfd.	92	88¼	Mackay Cos.	57½	47
American Tel. & Cable	75	75	Mackays Cos. pfd.	56	52
American Tel. & Tel.	100	—	Marconi Tel.	—	—
Brooklyn Rapid Transit.	41	37⅛	Metropolitan St. Ry.	35	—
Electric Boat	—	—	N. Y. & N. J. Tel.	—	—
Electric Boat pfd.	—	—	Western Union Tel.	69	66
Electric Vehicle	—	—	Westinghouse com.	110	80½
Electric Vehicle pfd.	—	—	Westinghouse pfd.	—	—

BOSTON.

	Oct. 15	Oct. 22		Oct. 15	Oct. 22
American Tel. & Tel.	102	99	Mass. Elec. Ry. pfd.	—	38
Cumberland Telephone.	98½	—	Mexican Telephone	1¾	5
Edison Elec. Illum.	198	199	New England Telep.	—	—
General Electric	112¾	106⅜	Western Tel. & Tel.	4½	—
Mass. Elec. Ry.	—	9	West. Tel. & Tel. pfd.	—	—

PHILADELPHIA.

	Oct. 15	Oct. 22		Oct. 15	Oct. 22
American Railways	46½	45	Phila. Electric	7⅛	6½
Elec. Co. of America	8½	8¼	Phila. Rapid Transit	17½	16¼
Elec. Storage Battery	39	35	Phila. Traction	86¾	86
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Oct. 15	Oct. 22		Oct. 15	Oct. 22
Chicago City Ry.	140	140	National Carbon	60	—
Chicago Edison	85	—	National Carbon pfd.	117	—
Chicago Subway	16¾	15	Union Traction	—	—
Chicago Tel. Co.	105	—	Union Traction pfd.	—	—
Metropolitan Elec. com.	20*	20*			

*Asked.

TRACTION INVESTIGATION.—Commenting on the traction inquiry in New York, the *Philadelphia Ledger* says: "The story of the sale of the Wall & Cortlandt Street Ferries Railway Company to the Metropolitan Securities Company, of New York, as developed in the Public Service Commission's inquiry, has a significance much beyond the sum involved in this particular 'deal.' It is a typical example of 'high finance' in traction affairs that commands attention by its simplicity and completeness and because of the light it throws upon other and larger transactions that have not been so explicitly set forth. Parties in this city said to be involved in the transaction make emphatic denial that they shared in the illicit profits, alleging that the moneys received by them were for money loaned. However that may be, the fact remains that a franchise worth $250,000 was foisted upon the unsuspecting investing public by promoters at a cost to the investors of nearly a million dollars. It does not relieve the baldness of this 'graft' to plead that such transactions are customary. That is the mischief of it. The very worst of it all is that these methods have actually become so common, or have been so long tolerated, that any one who publicly denounces them is thought to be 'knocking' corporations generally. The crowd, unfortunately, is not discriminating. It is all too ready to generalize and to put the broadest interpretation upon statements that are meant to be specific. This should teach caution to those who can discriminate, for reform can never be wrought through destruction. But if there were not an obvious necessity for reform; if reckless and dishonest finance did not flaunt itself; if the pressure of sound conservatism were brought to bear for the suppression of wrong rather than for the suppression of all mention of it, the 'knocker' would have no audience and the voice of the agitator would be unheard in the land."

ST. LOUIS INDEPENDENT TELEPHONY.—The Kinloch Long-Distance Telephone Company by circular to its stockholders has announced that the company would pass its regular quarterly dividend of 1¼ per cent due this month on its capital stock of $2,800,000. The circular informs the shareholders that in order to carry on new construction work the company has been using its profits, as the directors deemed it unwise to sell bonds of the company during the present depressed condition of the money market. The statement is made that the company will continue to use the surplus profits to pay for this work and will temporarily discontinue payment of dividends until bonds can be sold at a satisfactory price. Accompanying the circular the company's statement and balance sheet for the year to date was sent out with the following comment over the signature of President W. D. Orthwein: "The company is in strong financial condition and its surplus earnings applicable to dividends after payment of all interest charges exceed 7 per cent per annum on its outstanding stock. The net earnings after paying interest on bonds were more than $40,000 in excess of last year or an increase of 29 per cent. The number of telephones in service has increased 4939, or over 25 per cent during the twelvemonth ending Sept. 1." The Kinloch Long-Distance Company has paid a 5 per cent annual dividend since shortly after the formation of the company in 1899. About two years ago it absorbed the Kinloch Telephone Company, of St. Louis, which operated the St. Louis plant. The bonded indebtedness of the two companies is $3,314,000.

ABNER DOBLE COMPANY, of San Francisco, has found itself embarrassed for want of funds and has placed itself in the hands of its creditors, chiefly one or two large local banking interests and some Eastern steel concerns. A meeting of 35 or 40 of these creditors was held in New York on Oct. 22. A plan proposed for carrying on the business is for the Hibernia Bank to hold a first mortgage for its claims, on the factory, etc., now being finished, and for the other large creditors to take preferential bonds to the full amount of their accounts. Smaller creditors below $500 would be liquidated with cash at 50 cents on the dollar. Such a plan, it is believed, in view of the energy and ability of Mr. Doble, and the productive character of his business, will protect and satisfy everybody in the long run, while a peremptory closing of liens would do the reverse. The current assets are placed at $854,695, and the liabilities at $426,646, leaving an apparent net of $428,048. The land occupied is inventoried at $426,000, and the various buildings at slightly over $200,000. Accounts receivable net at $45,311, and the merchandise inventory shows $70,000.

DIVIDENDS.—Directors of the Commonwealth Edison Company have declared a dividend at the rate of 8 per cent on the first installments paid on Chicago Edison Company stock covering a period from Sept. 10 to Nov. 1. Directors of the Automatic Electric Company have declared the regular quarterly dividend of 2 per cent, payable Nov. 1. Directors of the Montreal Light, Heat & Power Company have declared the regular quarterly dividend of 1½ per cent, payable Nov. 15. Directors of the Amalgamated Copper Company have reduced the dividend from a quarterly payment of 2 per cent to 1 per cent, making the annual rate 4 per cent in place of the 8 per cent hitherto paid. This action followed a reduction of the Boston & Montana Mining Company dividend of $2 a share and $4 extra in place of the $2 share and $10 extra formerly paid. The Twin City Rapid Transit Company has declared a quarterly dividend of 1¼ per cent on the common stock, payable Nov. 15. The International Steam Pump Company has declared a regular quarterly dividend of 1½ per cent on the preferred stock, payable Nov. 1.

GENERAL ELECTRIC BUSINESS.—It is understood that the General Electric Company has put in operation a new credit system which, when fully worked out, is expected to increase the available working capital from 15 to 20 per cent, making it possible for the company to do from $10,000,000 to $12,000,000 more gross business than at present without any increase in capitalization. Under the company's old credit system settlement for goods was made on the basis of one-third of the face of the bill at the time of shipment, one-third in thirty days and the balance in sixty days. Under the new system, settlement is made as follows: Fifty per cent of the face of the bill at time of shipment, 40 per cent in thirty days and the balance in sixty days. In other words, the company now receives 25 per cent more cash inside the first thirty days than under the old system and thus has greater command over its own large cash resources.

AMERICAN TELEPHONE STOCK.—Advices from Boston state that the listing of American Telephone & Telegraph stock on the London Exchange carries out the plan which the company announced in July after the close of subscriptions to the $22,000,000 of new stock, when 30,000 shares of stock were taken by a prominent London financier to be distributed to investors in England and Scotland. The American Telephone Company has had for several years a considerable number of stockholders in England. The listing of the stock on the London Exchange will give a near market to these holders as well as afford a means for distribution of the stock sent abroad in July.

BELL TELEPHONE BONDS.—The underwriters of the American Telephone & Telegraph Company's $100,000,000 of convertible 4 per cent bonds will be called upon within the next few days for a 10 per cent payment on the underwriting subscription due Oct. 15. This will make a total call of 90 per cent upon the underwriters. In July, 1907, the call was for 10 per cent, and in April, 1907, 30 per cent. The remaining call of 10 per cent will be made on Jan. 1, 1908. Last March the underwriters received a check for 10 per cent from the syndicate managers which is said to have approximated the amount of bonds sold to the public.

INTERNATIONAL GRAPHOPHONE.—A motion has been granted by Justice McCall for the appointment of a receiver of the International Graphophone Company, a New York corporation, in an action brought by Attorney-General Jackson to dissolve the company, which has ceased to transact active business. Its plant and property were transferred to the Edison United Phonograph Company, a New Jersey corporation. James F. Lynch will be appointed receiver. The company was incorporated in 1889, with an authorized capital stock of $5,000,000.

ECCLESTON LUMBER COMPANY.—The Eccleston Lumber Company, of 44 Broadway, New York, with an office at Hackensack, N. J., made an assignment this week to Arthur A. Michell. The company deals in lumber, railroad ties, cross arms, and poles for electrical purposes. It has a capital stock of $50,000. John B. Eccleston is president and Samuel C. Eccleston treasurer. Most of the lumber came from the South. The company did a large business, it is said, for the actual working capital.

WESTERN ELECTRIC.—It is stated from Boston that the gross business of the Western Electric Company up to Oct. 1 showed a decrease of 15 per cent, compared with the same period of 1906. This means that for the first nine months of this year the company has been doing at the rate of approximately $60,000,000 of gross business, as compared with $70,000,000 for 1906.

ALLIS-CHALMERS ANNUAL REPORT.—At the moment of going to press we are in receipt of the sixth annual report of the Allis-Chalmers Company dated Oct. 21 and signed by President W. H. Whiteside. It is an interesting and encouraging document and embraces the transactions of the year ending June 30, 1907. The figures show steady and substantial improvement since April, 1907, at which time the company first began to receive benefits from the newly developed lines of machinery built in its enlarged West Allis plant, provided therefor; the net earnings in excess of all fixed charges for that period have been $489,267.86. The figures follow for the June and September quarters:

JUNE.

Gross profit	$780,277.18
Less general and selling expenses, interest on bonds, etc.	579,919.21
Net profit	$200,357.97

SEPTEMBER.

Gross profit	$852,836.49
Less general and selling expenses, interest on bonds, etc.	563,926.60
Net profit	$288,909.89

The report includes the consolidated balance sheet for the year, showing Allis-Chalmers and Bullock affairs for the year and giving a value of $37,028,120 for the real estate and factories and $15,337,200 in current assets, including $5,004,032 in notes receivable and $8,739,354 in stocks of merchandise. The company has $10,456,000 5 per cent bonds issued, $16,150,000 in preferred stock and $19,820,000 in common stock. The balance sheet, consolidated profit and loss account is as follows:

Balance June 30, 1906, as per last annual report		$157,481.19
Profit on operations of the last fiscal year after deducting expenses of manufacturing and selling, interest, dividends on preferred stock of The Bullock Electric Manufacturing Company, and provision for doubtful accounts	$1,226,242.00	
Charges for maintenance, repairs and renewals on buildings, machinery, plant, tools, etc.	$854,503.32	
Depreciation on buildings, machinery, plant, tools, etc.	253,987.42	
Interest on bonds, loans and notes payable	505,049.40	
	$1,613,540.14	
Operating deficit for the year		387,298.14
Deficit June 30, 1907, as per balance sheet		$229,816.95

With regard to the balance sheet it is stated: "Following the established practice of the company, all expenditures during the year for repairs to and replacement of standard patterns, also for the general up-keep of the plants, amounting to $854,503.32, together with $253,987.42 for depreciation of property, a total of $1,108,490.74, have been deducted in arriving at the net manufacturing profits. In addition to this substantial sum we have also reserved in the accounts and charged against the operations during the year $73,000 for bad and doubtful accounts, etc. Losses for the year on account of bad debts amount to about one-twentieth of 1 per cent. The most important transactions of the year reflected in the balance sheet relate to the bond issue. Of the $15,000,000 authorized, $12,854,000 have been issued, $854,000 of which were to reimburse the company for expenses incurred by additions to the West Allis extensions, being a part of the $3,000,000 of bonds reserved for specific purposes. Of the $12,854,000, $2,398,000 are Treasury bonds, leaving a net amount of $10,456,000 taken by stockholders and the syndicate. The stockholders' subscriptions had been fully paid at the close of the fiscal year, but there were still outstanding the last two installments of the syndicate, both of which have since been paid, thus fully discharging the syndicate's obligations to the company." It may be added that the company on June 30 had on hand orders aggregating $15,478,000.

It is in the power apparatus items that interest next lies, and with regard to these President Whiteside may be quoted as follows: "Probably the most important work which has been brought to a commercial consummation has been in the development of our steam turbine units, the unique features of which are fully protected by various patents owned by the company. In 1903 we designed and built our first turbo-generator, and its detail has required no material change—a strong testimony to the scientific accuracy of the principles first adopted. It is asserted with confidence that our turbo-generators are the best designed and most efficient machines on the American market. Sizes ranging from 500 to 7500 kilowatts have been completed and tested, and the success of these units under actual operating conditions is thoroughly established. Notwithstanding our recent advent into this field our sales of steam turbines have already reached nearly 100,000 kilowatts normal capacity, and compared with the previous year show in orders booked an increase of $800,000.

"In the important gas engine branch of our business substantial progress has been made. Each of our standard sizes has been designed, constructed and installed during the year, and our first gas engines are in successful operation. Orders to Aug. 1, 1907, for the horizontal, twin-tandem and double-acting type of gas engines, ranging in capacity from 500 to 5000 horsepower, aggregate 189,350 horse-power. One of our notable contracts covers the electrification of a steel plant requiring gas engine electrical units of an aggregate capacity approximating 60,000 horse-power. This order is believed to be the forerunner of a great many others of similar character, because of the great saving effected by this means in the utilization of gases produced in the manufacture of steel and hitherto wasted. Another important contract, which has been awarded us by an electric railway company, is for traction purposes the largest installation in America of electrical units driven by gas engines to operate on producer gas. The equipment comprises three horizontal, twin-tandem gas engines of 1500 horse-power each, direct-connected to 1000-kw, 3-phase, 25-cycle alternators of our manufacture and includes all sub-station apparatus.

"Although we have but recently undertaken the manufacture of hydraulic turbines, we installed and placed in operation during the year ten complete hydro-electric plants, having a combined output of 105,000 horse-power, and it is gratifying to report duplicate orders from the largest companies interested in these plants. Particular reference is made to the highly satisfactory performance of a 32,000-hp installation furnished one of the largest water power developments in the South, for which we have recently contracted to supply six additional units of identical design.

"The air-brake department was organized about July 1, 1906, to exploit the sale of air-brake equipments, pursuant to an arrangement made with Mr. N. A. Christensen, inventor, whereby your company possesses the exclusive patent rights to manufacture and sell the 'Christensen' air-brakes to urban and interurban electric railways. The 'Christensen' brake has been extensively used for years, and its merits are widely recognized. A reasonable degree of success has already rewarded our efforts to establish ourselves in this line of business.

"During the past year we have completed the development and manufacture of a considerable number of large alternating-current and direct-current generators, rotary converters, induction and direct-current motors in all sizes and capacities, transformers for both power and lighting service, street railway motor equipments and electric hoists, all of which are in successful operation.

"It is worthy of note that notwithstanding the large inroads made by the steam turbine and gas engine, our Corliss engine business continues in steady volume, particularly for the medium and smaller sizes."

This important annual report shows that the finance and executive committees have been abolished; this places the management of the company in the hands of Elbert H. Gary and W. H. Whiteside. The newly elected directors are: Elbert H. Gary, Edmund C. Converse, Charles MacVeagh, general solicitor of the United States Steel Corporation, and Alexander F. Banks, president of the Joliet Eastern Railroad, which is operated by the United States Steel Corporation. This materially strengthens the board and places the financial affairs of the company in excellent hands. The company has ample funds now to carry on its operations in an efficient manner. The full list of directors is as follows: Term expiring 1907—William W. Allis, Milwaukee, Wis.; Lahman F. Bower, Milwaukee, Wis.; Elbert H. Gary, New York; Charles MacVeagh, New York; William A. Read, New York; Cornelius Vanderbilt, New York. Term expiring 1908—Edward D. Adams, New York; Alexander F. Banks, Chicago, Ill.; Edmund C. Converse, New York; Mark T. Cox, East Orange, N. J.; Joseph S. Neave, Cincinnati, Ohio; Henry Woodland, Milwaukee, Wis. Term expiring 1909—Charles Allis, Milwaukee, Wis.; George Bullock, New York; Herman W. Falk, Milwaukee, Wis.; William V. Kelley, Chicago, Ill.; Max Pam, Chicago, Ill.; Walter H. Whiteside, Milwaukee, Wis.

GENERAL NEWS

Construction News.

DOTHAN, ALA.—Plans are being made by A. J. Smith, of Dothan, to organize a company to erect a 3000-hp hydraulic plant.

FORT MORGAN, ALA.—Bids will be received until Nov. 14 by Captain L. F. Garrard for construction of building for pump house, installing two horizontal tubular boilers (50 hp), two compound duplex pumps, ice plant and cold storage plant.

MONTGOMERY, ALA.—Extensive improvements and additions have been authorized to be made to the plant and system of the Montgomery Light & Water Power Company, which will involve an expenditure of over $100,000. The new work consists of an additional transmission line from Montgomery to the water power plant on the Tallapoosa River, 30 miles distant. In connection with the new transmission line additional transformers and the latest methods of lightning arresters will be installed. The company will extend both the gas and electric lighting service to the suburbs, and also make extensive improvements to its gas system in this city. R. J. Chambers is general manager.

GLOBE, ARIZ.—The city has entered into a contract with the Globe Electric Light & Gas Company for arc lamps for street lighting. The company will put in an entire new system for this service. The dynamo ordered has a capacity of 50 lamps, new poles will be erected and the entire city rewired for the arc system.

EARL, ARK.—The Earl Light & Power Company has been organized with a capital stock of $10,000. The directors are: L. J. Machen, W. E. Duffus, C. C. Bird and others.

SMITHVILLE, ARK.—The Arbuckle Mining & Milling Company is reported to be interested in the construction of a dam on Strawberry Creek, near Smithville, to be 300 feet long and 13 feet high. The power will be used to generate electricity for use in crushing ore at the various zinc mines at Smithville and Calamine. The company also proposes to construct another dam on Spring River to furnish power for operating an electric car line.

SULPHUR SPRINGS, ARK.—Plans are being prepared by Smith & Powers, of this city, for an electric light plant and water works combined, to cost about $25,000.

BODIE, CAL.—The Green Creek Electric & Water Power Company has been incorporated for the purpose of furnishing electrical energy to Bodie, Masonic, Bridgeport and Aurora.

CHICO, CAL.—The application of Guy R. Kennedy in behalf of L. D. Macy for a franchise to construct and operate an electric lighting and power plant in this city was granted in amended form by the City Council.

COMPTON, CAL.—Work has been discontinued by E. Riveroll & Company, contractors, on the construction of the plant for the Compton Electric Light & Power Company, and an investigation is demanded by W. D. Gould, acting as an attorney for the stockholders of the company, who declare that they were mulcted in building the plant.

FRESNO, CAL.—Bids will be received at the office of the Treasury Department, Washington, D. C., until Oct. 30, for furnishing lamp fixtures for public buildings at Fresno, under the control of the Treasury Department.

LOS ANGELES, CAL.—The Los Angeles-Pacific Railroad has made application to the City Trustees for a franchise commencing at the end of its Franklin Avenue franchise, Hollywood, running west on Franklin Avenue to Cahuenga, thence to Highland Avenue to the city limits.

OAKLAND, CAL.—The Oakland Traction Company has petitioned for a franchise for an electric railway from the city limits to North Piedmont Heights.

PALO ALTO, CAL.—The Pacific Telephone & Telegraph Company is remodeling its telephone plant in this city at a cost of between $60,000 and $75,000. The company is placing its wires in underground conduits in the business section of the city, and the common battery system is to replace the system now in use.

PLACERVILLE, CAL.—The city clerk writes that the city has not taken any steps in regard to establishing a municipal plant and is only seeking information relative to the plant. He also states that the city has an excellent opportunity to install a plant, but must first submit the proposition to the vote of the people.

PASADENA, CAL.—Superintendent William Glass, of the Municipal Lighting Department, has discovered that the city can save $329,000 by entering into an arrangement with the Sunset Telephone Company, whereby the company will permit the municipality to have free use of its poles and certain ducts in conduits, provided the city does not insist upon the telephone company paying anything for the privilege for doing business in Pasadena. If the scheme is carried out there may be no need for an additional bond issue to enlarge the plant.

REDDING, CAL.—The Northern California Power Company will have 32,000 hp of electrical energy developed in less than a year. The company has closed a deal in Red Bluff for 2700 acres in Manton section, particularly valuable for the water rights on connection, and means the beginning of construction work on a fifth power plant of the company. The capacity of this unit is to be 5000 hp. The new plant will be on Battle Creek, five miles south of the twin power plants now in operation and located at Volta, near Shingletown. The company has a third plant in operation at Kilare on Cow Creek. The fourth plant, the largest of all, is under construction on Battle Creek at Horseshoe Bend. This plant will generate 16,000 hp, or as much as the other four combined. The dam for this plant is 110 feet high.

RIVERSIDE, CAL.—J. E. Tibbetts and associates have asked for a franchise from the city of Newport to cover a gas, electric and water plant, which the syndicate desires to establish there. The company proposes to have one central power plant and pump water by electricity. The surrounding places will be taken in.

RIVERSIDE, CAL.—A franchise has been granted for the construction of an electric railway from Riverside to the new town of Crestmore, but owing to the expense of poles, the Crescent City Railroad Company, which was incorporated to build the road, will endeavor to have the franchise changed to allow the use of gasoline motor power to run the cars to the connection with the main street car line.

SAN DIEGO, CAL.—The San Diego Electric Railway is contemplating the construction of a power plant to cost about $25,000.

SAN DIEGO, CAL.—The San Diego Electric Railway Company is building an extension to the boiler room of its power plant. Three new boilers will be installed, one of 250 hp and two of 400 hp each. This improvement will involve an expenditure of about $25,000.

SAN FRANCISCO, CAL.—The Century-Klein Electric Company has applied to the Superior Court to change its name to the Sterling Electric Company.

SAN FRANCISCO, CAL.—The franchise of the Parkside Traction Company has been passed by the Board of Supervisors, the company agreeing to sell the road to the city at a fair valuation any time during the last 10 years of its 25-year franchise, and also to build its main line on Twentieth Avenue instead of the present boulevard.

SAN JOSE, CAL.—Charles H. Pieper, city engineer, has presented his report on the construction of a municipal electric light plant for the city to the Mayor and City Council, and recommends the selection of an electrical steam driven unit of not less than 300-kw capacity, arranged to permit of future extension; the total cost of the proposed plant, together with pole lines, underground conduits, lamps, apparatus and appurtenances, would cost about $200,000.

SAN LUIS OBISPO, CAL.—The San Luis Obispo Gas & Electric Company's electric plant was damaged by fire Oct. 13, caused from an explosion of oil under the boiler. The city will be in darkness for about a week. The loss is estimated at about $2,500. B. Call is superintendent.

SANTA ROSA, CAL.—The Snow Mountain Water & Power Company has petitioned the Board of Supervisors for permission to erect 25 additional lines through Sonoma County, to be feeders from the main wires. Among the places to be touched by these wires will be Sebastopool, by the way of Forestville; Trenton, Fulton, the Todd district, Guerneville and all the country adjacent thereto; Sonoma, Windsor, Occidental, Molino, Duncan's Mills, Bodega Corners, Bloomfield, Valley Ford, Two Rocks, Penngrove, Danman's Station, Tomales, Marin County and other places.

VENTURA, CAL.—Application has been made to the Board of Supervisors by F. M. Packard and Julian Jones, of Los Angeles, for a franchise for an electric railway to the cement rock mines in the Matilija Canyon. They have asked for a franchise through Ventura, along Oak Street to Ventura Avenue to the city limits.

NEW HAVEN, CONN.—The New York, New Haven & Hartford Railroad Company is contemplating making some changes in the machinery at its power house in Danielson, known as Dyer Dam, to consist of 11,000-volt, 25-cycle, three-phase equipment, to take the place of the 11,000-volt, 60-cycle, three-phase equipment now in use. The substitution is being made for the purpose of operating the power house in connection with the 25-cycle system of the Norwich power house, some miles distant.

TERRYVILLE, CONN.—At the town meeting held recently a committee was appointed and authorized to make a contract for lighting the streets of the town with electricity for five years at an annual cost of $700.

WASHINGTON, D. C.—The plans of Secretary Wilson, of the Department of Agriculture, for an underground conduit between the Bureau of Engraving and the printing building and the new buildings of the Department of Agriculture, in order to furnish energy for electric illumination and heating of the latter buildings, is reported to have been approved by the District Commissioners.

WASHINGTON, D. C.—The Wagner Electric Company, of St. Louis, Mo., was awarded the contract to supply transformers for use in connection with the telephone and electric lighting work at the Government irrigation plant at Salt River, Ariz. The amount of the contract is

$23,970. The contract was also awarded for the switchboard apparatus for the Salt River project to the General Electric Company, of Schenectady, N. Y.

KEY WEST BARRACKS, FLA.—Bids will be received until Nov. 9 by the quartermaster at this post for furnishing a steam boiler of 125 hp with all accessories complete. Bids to state price f. o. b., both Key West, Fla., and Mallory Steamship Line, New York City, N. Y.

ALBANY, GA.—It is reported that the Albany Power Company will soon call for bids for the construction of a dam and power house and electrical machinery for generating electricity at Porter Shoals on Flint River, near Albany. The company plans to develop 12,000 horse-power. Alexander W. Smith, Frank L. Meufville and E. M. Underwood are interested in the enterprise.

AMERICUS, GA.—The Americus Railway & Light Company, recently incorporated, will soon commence work on the construction of the new power plant. The new company has already purchased the old gas and electric lighting plant in Americus, but will erect the new buildings in another part of the city and install new and more powerful machinery.

ATLANTA, GA.—Sealed proposals and specifications in duplicate will be received by the Board of Water Commissioners and special committee of the Council until Nov. 25 for furnishing and erecting complete, within the building and on foundation furnished by the city, and making necessary connections to 36-inch suction and 30-inch discharge mains of water works, and also 10-inch steam main, at the pumping station No. 2, Atlanta water works, about three miles from the city, on the Southern Belt Railroad, for one 20-million and one 25-million gallon centrifugal pump, to be operated by electric motor, compound triple expansion condensing engine or steam turbine, and for direct pumpage against a head of 120 lbs. domestic and 160 lbs. fire pressure. Said proposals to state the number of million foot-pounds duty guaranteed per 1000 lbs. steam, and no propositon to furnish anything but pump complete with power to operate it (this not to include boilers), and to make connections to mains, as above specified, both water and steam, will be considered. F. P. Rice is chairman of joint committee.

BAINBRIDGE, GA.—It is reported that a Chicago corporation, through Col. W. H. Krause, T. E. Greer and others, has made application to the City Council for a franchise to construct and operate a street railway system on several streets of the city.

FORT VALLEY, GA.—The Fort Valley Telephone Company has filed application with the Railroad Commission for its approval for an issue of $10,000 in bonds, the proceeds to be used in refunding present indebtedness and making certain extensions and improvements.

GAINESVILLE, GA.—The management of the North Georgia Electric Company on Oct. 15 was taken from the hands of the receiver and placed under the control and management of its officers, by order of Judge Newman, of the United States District Court.

MACON, GA.—The Macon Power Company has applied to the State Railroad Commission for permission to issue $150,000 in capital stock.

MACON, GA.—The new company owning the property of the Macon Railway & Light Company has been organized and has assumed the control of the railway and lighting system in the city. The officers of the company are as follows: W. J. Massee, president; Jacob S. Collins, of Savannah, vice-president; J. E. Jaudon, secretary and treasurer; J. W. McFarland, of Chattanooga, general superintendent.

SAVANNAH, GA.—The City Council on Oct. 16 opened the bids submitted for lighting the city. The Savannah Electric Company submitted several propositions for lighting the streets. The company offered as an economical measure to the city to continue the present contract for a period of two years for the sum of $25 per lamp per year. This would mean a saving of $25,380 a year, and the lamps would cost $13,700; for all-night and every night schedule, $28 per lamp per year. Another proposition offered by the company is to furnish the city with service for an additional five or ten years at the city's option at actual cost, which will include the cost of operation, depreciation and a return upon the investment devoted to the city lighting of 8 per cent. In case the city accepts this offer the company offers to install such a system as a competent board of engineers shall determine best suited to the needs of the city at the time of their recommendation. Under a five-year contract, with privilege of running for another five years for 540 lamps or more, the company offers to furnish magnetite lamps manufactured by the General Electric Company, the Westinghouse Company, or any other standard manufacturer as follows: Straight five-year contract, or five-year contract with privilege of renewal for additional five years, moonlight schedule, $66 per lamp per year; all-night, $68 per lamp per year. Ten-year contract: Moonlight schedule, $59 per lamp per year; all-night, $61 per lamp per year. For lamps on ornamental poles in underground district, $15 extra each, poles not to cost more than $50 each. For incandescent lamps for five-year contract, with privilege of the city to renew for another five years, were as follows: Moonlight schedule, 25-cp lamps, $22.50 per lamp per year; 50-cp lamps, $28; 75-cp lamps, $39; all-night schedule, 25-cp lamps, $23; 50-cp lamps, $30; 75-cp lamps, $41. Under ten-year contract, moonlight schedule, the following prices were given: 25-cp lamps, $26.50 per lamp; 75-cp lamps, $36; all-night schedule: 25-cp lamps, $21; 50-cp lamps, $28; 75-cp lamps, $38. The company also agrees, in case any of the bids for arc lamps are accepted, to furnish free of cost to the city electricity for lamps and motors to the same total sum paid by the city during the year ending Sept. 30, 1907. All electricity used in excess of this to be paid for by the city at the rate of 7½ cents per kw-hour. The proposition submitted by the Savannah Lighting Company for lighting the city is as follows: For the first five years for all-night service, $65 per lamp per year; moonlight schedule, $64 per lamp per year; for the second five years, $60 each per year. For incandescent lamps for the five and ten years as follows: For 20-cp lamps, $17 per lamp per year; 50-cp lamps, $30; 65-cp lamps, $37. The Savannah Lighting Company guaranteed to commence operations within five months after the contract was awarded.

LEWISTON, IDA.—The Washington-Idaho Light & Power Company has recently closed contracts with the City Councils of Uniontown and Colton for furnishing the towns with electric energy for lighting and for pumping the city water. The company has secured a 25-year franchise to erect transmission lines on the streets of the towns. The extension of the company's lines will involve an expenditure of about $25,000. The addition of Uniontown and Colton makes ten cities in the Inland Empire that are served with electricity by the Washington-Idaho Light & Power Company. These towns, with Genesee, Moscow and Pullman, receive power from the water power plant of the Lewiston-Clarkson Company, of Asotin, while Palouse, Garfield, Oakesdale, Farmington and Tekoa receive their service from the Post Falls plant.

ASHLEY, ILL.—The City Council has granted a franchise to Charles W. Lafferty, of Casey, to erect and maintain a telephone and telegraph system in this city.

CAIRO, ILL.—The Cairo Electric & Traction Company is planning to make extensive changes and improvements to its power plant, and will soon place orders for the following equipment: Two turbine generators, 500 kw; one 300-kw motor generator set, 2300-volt alternating current to 550-volt direct current; one 200-kw motor generator set, 2300-volt alternating current to 550-volt direct current. O. C. Macy is manager.

BRIDGETON, ME.—The Bridgeton Water & Electric Company has notified its patrons that the meter system will be used exclusively in the consumption of electricity for lighting purposes, as soon as the meters can be installed. The reason of the change is due to the installation of a day service, which was not contemplated when the present flat rates were established.

BALTIMORE, MD.—The United Railways & Electric Company has not yet prepared plans for the reconstruction of its power plant, which was recently destroyed by fire.

ADAMS, MASS.—The Selectmen have granted the Berkshire Street Railway Company permission to erect poles for its high-tension line from Pittsfield to the Zylonite power station. The contract for the work has been awarded to Fred T. Ley & Company, of Springfield, for $65,000.

CLINTON, MASS.—The Bigelow Carpet Company is making arrangements to erect a new power plant.

MIDDLEBORO, MASS.—The management of the municipal electric lighting plant is making arrangements to establish a day service in the near future.

STOCKBRIDGE, MASS.—The Stockbridge Electric Light Company has petitioned the State Board of Gas and Electric Light Commissioners for authority to issue $25,000 of capital stock to be used in building a new plant.

BERRIEN SPRINGS, MICH.—Bids will be received by the village of Berrien Springs until Nov. 4 for the construction of a municipal electric light plant. The street lighting system will consist of 25 street lamps and about five miles of wire, etc. A. B. Ayers is president of the Board of Trustees.

CORUNNA, MICH.—The Shiawassee Light & Power Company is preparing to raise its dam at Shiatown from eight to fifteen feet.

GRAND RAPIDS, MICH.—We are informed that the Grand Rapids Electric Railway Company will place contracts during the next 30 days for the construction of two new electric lines; one from Bay City to Grand Haven and the other from Grand Rapids to Montpelier, Ohio.

MANCHESTER, MICH.—W. J. Hoffer, village clerk, writes that the citizens have voted in favor of purchasing the electric light plant owned by J. H. Kingsley, to be operated as a municipal plant.

PAINESDALE, MICH.—W. A. Rankin, engineer, writes that no contracts will be let until spring for the proposed power plant to be constructed about five miles from Painesdale.

SAGINAW, MICH.—The contract for building the new exchange building of the Valley Telephone Company has been awarded to Kerns & Spindler. A complete equipment for lighting and heating the building will be installed in the basement. The company is extending its conduit system as rapidly as possible and an additional force of men will be put to work as soon as available.

AKELY, MINN.—The Red River Lumber Company has placed an order for a 300-hp engine and a new dynamo to double the capacity of the electric light plant.

CROOKSTON, MINN.—The City Council has granted W. A. Marin a franchise to operate a street railway system in the city.

ELK RIVER, MINN.—The Mississippi River Electric Power Company, which already owns undeveloped water power on the Mississippi River at this place, Monticello and Clearwater, has purchased another dam site near Anoka. Flowage rights along the river from Anoka to this village have also been purchased.

LUVERNE, MINN.—Extensive improvements are being made to the plant and system of the Luverne Telephone Company in this place.

MINNEAPOLIS, MINN.—Instructions have been given by the City Council to advertise for bids for supplying the city with 7000 lamp sockets with incandescent attachments. Bids will also be invited for furnishing gas, and also for electric and gas incandescent lighting.

MINNEAPOLIS, MINN.—Bids will be received at the office of L. A. Lydiard, city clerk, until Nov. 8, for lighting the streets and avenues of this city with gas and electricity for the year 1908; also for supplying gas for the street lamps of the city for the year 1908; bids will also be received for furnishing about 7000 incandescent gas street lamps.

ST. CHARLES, MO.—The City Council has sent a notice to J. T. W. Rudsill, of East St. Louis, Ill., and other promoters, signifying its willingness to consider granting a 50-year street railway franchise. The Council last spring refused to grant Mr. Rudsill a street railway franchise for 50 years, but the demand of the people for a street railway system has led the Council to reconsider its action.

ST. JOSEPH, MO.—It is said that the St. Joseph Railway, Light & Power Company will begin work on the construction of the extension of the Krug Park line between St. Joseph and Savannah within 60 days. J. H. Van Brunt is manager of the company.

ST. MICHAEL'S, MD.—Walter L. Butler, of Philadelphia, Pa., has applied to the Town Commissioners for a franchise to establish an electric light plant.

BEAR CREEK, MONT.—It is reported that an electric light plant and water works system will be installed in this town.

VIRGINIA CITY, MONT.—An electric light plant will be installed here, and the water power of Blaine Springs Creek will be developed to furnish power for operating the plant.

ARLINGTON, NEB.—The Arlington Electric Light & Power Company is contemplating improvements to its power plant, which include the building of an additon to the power house and installation of a 130-hp boiler and an engine of 90 hp.

CENTRAL CITY, NEB.—The City Council on Oct. 11 passed to its second reading an ordinance granting an electric light franchise to L. S. Jenkins and H. D. Forrest, of Omaha. The ordinance provides at the end of five years the city may, if it desires, purchase the plant at a fair market value to be determined by appraisers. Messrs. Jenkins and Forrest will put in a plant at a cost of about $15,000 and will erect a power house on a site near the city roller mill. The city on Oct. 8 severed all relations with the gas company, and since that time the streets have been in darkness.

EXETER, NEB.—W. W. Kimberly, village clerk, writes that bids will be received until Nov. 1 for the construction of a power plant to cost $15,000. The National Construction Company, of South Bend, Ind., has charge of the construction work.

PLATTSMOUTH, NEB.—The Plattsmouth Telephone Company is contemplating increasing its capital stock to $300,000.

PLATTSMOUTH, NEB.—The Omaha Electric Light & Power Company has secured the contract for lighting the city of Plattsmouth.

PLATTSMOUTH, NEB.—Earl H. Wescott, of Plattsmouth, writes that he proposes to build a transmission line eight miles in length to connect with the power plant of the Omaha Electric Light & Power Company at Omaha, and will need sub-station equipment including transformers.

ST. PAUL, NEB.—The question of issuing $10,000 in bonds for an electric light plant is under consideration.

SCOTTS BLUFF, NEB.—The construction of an electric light plant is now under consideration.

TECUMSEH, NEB.—Work has commmenced on the rebuilding of the municipal electric lightning plant and surveys are being made for the location of street lamps. An addition will be built to the old power house to make room to place the new machinery. Arc lamps will be placed in the business section of the city. The Mayor and Council are now considering establishing an all night service when the new plant is installed. J. E. Marx is superintendent.

TEKAMAH, NEB.—The City Council has awarded the contract for installing the electric light plant to Bortenlanger & Company, of Omaha. The contract calls for a 125-hp engine, two 70-hp boilers and a dynamo of 75-kw capacity.

WAHOO, NEB.—Edward Lehnkuhl, Mayor, writes that the proposed water works and electric light plant will cost between $50,000 and $60,000. The engineer has not yet been selected.

CASTILE, N. Y.—James C. Horning, of Lamont, writes that the proposed dam to be constructed across East Koy Creek to develop power for electricity to supply Castile, Silver Springs and Gainesville will cost from $15,000 to $20,000. The company has not yet been organized, but it is hoped to have the work completed by next spring.

GLENS FALLS, N. Y.—The International Paper Company is contemplating building a large dam about two miles south of Spier Falls to furnish power for a pulp mill or an electrical plant. William Curtis, Jr., is superintendent of construction.

LINDENHURST, L. I., N. Y.—The Town Board and Board of Highway Commissioners have granted the South Shore Traction Company a street railway franchise.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, New York City, until Oct. 28, for installing electric equipment in new School 5, Borough of Brooklyn.

NEW YORK, N. Y.—Bids will be received until Oct. 28 by Robert Watchorn, commissioner of immigration, Eilis Island, for furnishing material and installing electric conduits and wiring in new dormitories, first and second cabin rooms and balcony, third floor main building, at the United States Immigration Station, Ellis Island.

WATERTOWN, N. Y.—Justice Andrews has made an order returnable Nov. 2, directing the stockholders of the Citizens' Telephone Company to show cause why it should not be dissolved, it having been declared bankrupt. Oliver Watson is receiver for the company.

WOLCOTT, N. Y.—O. M. Curtis, proprietor of the Wolcott electric light plant, is contemplating the construction of a dam across Wolcott Creek.

SMITHFIELD, N. C.—The Town Commissioners have appointed a committee, consisting of N. M. Lawrence, N. B. Grantham and E. H. Brooks, to investigate the cost of constructing an electric light plant, water works and sewerage systems.

CINCINNATI, OHIO.—Bids will be received until Nov. 14 by the board of trustees, Memorial Association of Hamilton County, at the office of Samuel Hannaford & Sons, architects, for furnishing material and installing light fixtures for the Soldiers' and Sailors' Memorial Building at Grant and Elm streets. Elias R. Montfort is president of the board.

CLEVELAND, OHIO.—The Cuyahoga Light Company has petitioned the City Council for an electric lighting and steam and hot water franchise in the downtown business district. The lighting committees of the Board of Public Service and the Council on Oct. 16 voted to recommend the granting of a franchise to the Cuyahoga Light Company. A maximum price of 5½ cents per kw-hour was agreed upon for electric lighting and other important provisions were embodied in the proposed franchise. Municipal ownership was provided for, and at any time, on six months' notice, the city may purchase the plant for the cost of reproduction, less depreciation, plus 10 per cent. The franchise is to be revoked in case of consolidation or working agreement with the Cleveland Electric Illuminating Company. The company agreed to accept, should the city demand it at any future time, an extension of the franchise requiring it to extend its service to the city limits. Heating will be charged for at the rate of 27½ cents per sq. ft. of radiation. This charge is to be readjusted at the end of two years.

COLUMBUS, OHIO.—Bids will be received until Oct. 30 by the Board of Public Service (E. F. McGuire, secretary) for furnishing material and doing the following work at the municipal electric light plant, Dublin Avenue: Boilers, blow-off tunnel, foundation for additional boilers, continuation of ash pit tunnel, retaining wall and driveway.

EUGENE, ORE.—The Pacific Light & Power Company, of Junction City, is considering the construction of a power plant at Triangle Lake, about 30 miles west of Eugene, and will extend its transmission lines to Eugene, Corvallis and Junction City.

BRACKENRIDGE, PA.—The Saxonburg, Tarentum & Butler Street Railway Company has accepted the franchise granted some time ago by the Town Council for a right of way through the town.

CORRY, PA.—C. P. Northrop, president of the Corry & Columbus Street Railway Company, writes that 15 miles of track will be built during the next season. The company is also considering the purchase of a generator and gas engine and a double truck combination passenger and baggage car. He also states that the company will install a lighting plant in the future.

EASTON, PA.—The Warner Arc Lamp Company, manufacturer of the lamps now in use in the city of Easton, which have caused the management of the municipal electric light plant so much trouble, has notified C. S. Neiman, superintendent, that it will replace the present lamps with another type of lamp without any additional expense to the city.

GREENSBURG, PA.—The West Penn Railways Company has secured a right of way for a new electric railway between Hunker and Scott Haven, connecting with West Newton.

KANE, PA.—The new plant of the Kane Electric Light, Heat & Power Company is nearly completed and will soon be put into operation. A 125-hp Struthers & Wells engine has been placed and a generator installed; another 250-hp engine of the same make will be installed as soon as the foundation can be built. The plant when completed will have a capacity of 500 hp.

NEWTOWN, PA.—The Newtown Electric Street Railway Company has been authorized by the State Department to change its corporate title to the Bucks County Electric Railway Company. The old Buck County Electric Railway has passed out of existence, its property having been purchased by the Doylestown & Willow Grove Railway Company.

PEN ARGYL, PA.—Arrangements are being made to improve the electric lighting system in this place. A new dynamo has been recently installed at the power house and also other equipment. The present transmission lines will be replaced with new and heavier wire than that now in use, and new poles will be erected.

SHAMOKIN, PA.—The Shamokin & Edgewood Electric Railway Company has filed notice at the State Department of 53 miles of extensions, which will be constructed as soon as possible. Monroe H. Kulp is president.

SHEFFIELD, PA.—The Youngsville & Sugar Grove Street Railway Company has notified the State Department of an increase indebtedness

from $34,000 to $500,000; also of an increase in capital stock from $80,000 to $200,000, for the purpose of extending the line from Youngsville to Warren.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has increased its indebtedness from $300,000 to $600,000 and its capital stock from $300,000 to $600,000. The company has commenced work on an extension from Greencastle to and beyond Chambersburg and over certain streets in Chambersburg. The work is being done by the company itself, and it is expected to have the new line in operation in about eight months. The company will add another engine and generator to the Waynesboro plant, and boosters and transformers will be placed along the new line.

PASCOAG, R. I.—A new Dillon boiler of 125 hp has been purchased for the municipal electric light plant. The old boiler will be taken out and the boiler house enlarged.

PROVIDENCE, R. I.—The Board of Aldermen has adopted a resolution recommending that the Narragansett Electric Lighting Company be permitted to install, at its own expense, a system of underground wires, conduits and appurtenances on the premises of the City Hospital on Eaton Street. The electricity to be used for light and power will then be purchased at meter rates, effecting a saving of $14,000 for an electric light plant, exclusive of the wiring and appurtenances, and nearly $500 per annum over the cost of maintaining the plant. The estimated cost of an electric plant for the City Hospital is $14,000, exclusive of the wiring and appurtenances, and the cost of operating such a plant would be $5,325 per annum, while the cost of purchasing electricity from the Narragansett Electric Lighting Company will be $4,900 per year. The heating and ventilating system recommended by the consulting engineers and architects and adopted by the committee provides for a plant in which no changes will be necessary outside of the engine and boiler room in case an electric plant is installed later.

UNION, S. C.—J. A. Brown, of this city, acting as agent for other parties, has applied to the Town Council for a perpetual franchise to construct and maintain an electric light and power plant, guaranteeing to construct the plant within 12 months.

ABERDEEN, S. D.—The Wagner, Lake Andes & Armour Traction Company has petitioned the City Council for a franchise for an electric light and power plant. The company proposes to install a plant at a cost of about $150,000, and will furnish an all-night service to business houses and residences.

MITCHELL, S. D.—The City Council has granted another extension of time on the electric light franchise proposition in order to give the Mitchell Gas Company an opportunity to get through with the receivership and start out on a new basis. When the business is settled in the federal court the plant will be purchased by a new company, which has just made application to the Council for a franchise, which will probably be granted.

CLEVELAND, TENN.—J. W. Adams and associates, of Chattanooga, have received a franchise for an electric light and power plant.

COLUMBIA, TENN.—Owing to the inefficient service furnished by the Columbia Water & Light Company the city of Columbia, through its attorney, has entered suit in the chancery court against the company to have the contracts between the city and the company annulled and also the franchise of the company annulled. The city has frequently been in darkness, especially during the past few months, and has for days at a time been without water.

JOHNSON CITY, TENN.—The Johnson City Traction Company will soon place contracts for the one-half mile extension of track to the National Soldiers' Home. It is reported that the company is also contemplating building an addition to its car sheds and will purchase a 200-kw, 2300-volt, three-phase alternator.

McKENZIE, TENN.—Edward Moseley, cashier First State Bank, and others are considering the matter of installing an electric light plant here in conjunction with an ice plant.

NASHVILLE, TENN.—William E. Hamilton, of Columbus, Ohio, is reported to be interested in plans for extensive water power developments and the erection of an electric light and power plant in Tennessee.

NEWPORT, TENN.—The city has voted to issue $50,000 in bonds for the construction of an electric light plant, water system and sewer system.

ABILENE, TEX.—The Roberts Telephone & Electric Company has been placed in the hands of receivers appointed by Judge J. H. Calhoun.

EL PASO, TEX.—L. D. Gilbert, secretary of the Cement Engineering Company, of Los Angeles, Cal., engineers in charge of the construction of the cement plant for the Southwestern Portland Cement Company to be erected in El Paso, wrote under date of Oct. 12 that machinery had not yet been purchased at that date, but that requests for prices have been sent out for most of it, and he expects to let contracts for the machinery in about four weeks. There will be 14 buildings erected, with an aggregate floor space of 80,000 square feet. The equipment of the proposed power plant will consist of two 750-kw, 440-volt, 25-cycle, three-phase generators, either direct connected to cross-compound Corliss engines, or steam turbines, to operate on 175 lbs. gauge steam pressure and 125 degrees superheat. The plant will be motor driven throughout, motors being direct connected to all the large size grinding machines.

SALT LAKE CITY, UTAH.—The City Council has granted the Utah Light & Railroad Company a franchise to lay additional tracks from the intersection of Twelfth West Street to Fourth North Street.

FAIRHAVEN, VT.—The Fairhaven Electric Company has recently installed additional machinery in its plant and is arranging to improve the service by increasing the voltage.

CHEHALIS, WASH.—B. E. Clement has been granted a franchise to erect and operate an independent telephone exchange in this place.

CHEWELAH, WASH.—The City Council has awarded the contract for the electric plant, wire and electric fixtures to the Fairbanks & Morse Company; the 12-in. water pipe to the Washington Pipe & Foundry Company. The Council has rejected the bids on the power house, which, with the excavation and refilling for the pipe line, will be done under the supervision of the Council.

PASCO, WASH.—The capital stock of the Pasco Light & Water Company has been increased from $25,000 to $50,000.

ASHLAND, WIS.—The City Council on Oct. 11 voted to accept the proposition of the Chippewa Valley Construction Company to transmit electricity to this city from its plant at Copper Falls, the city to lease the power plant of the Chippewa Valley Electric Railway for three years, with the option of purchase at that time. A. E. Appleyard, of Boston, Mass., is president of the company, and promises to supply 6000 hp from its plant at Copper Falls, 18 miles south of Ashland, by next June. The contract is for a period of 15 years.

EAU CLAIRE, WIS.—The Northwestern Lumber Company has decided to build a high dam on Eau Claire River to develop power for manufacturing purposes.

ONALASKA, WIS.—The La Crosse Water Power Company has applied for a franchise to erect its lines through this village.

OSCEOLA, WIS.—Harry C. Harding and others are arranging to establish an electric lighting system here by a connection with the plant of the General Electric Company at St. Croix Falls.

RIPON, WIS.—A committee of the Common Council has been appointed to secure the services of the State Railway Commission for an investigation of the Ripon Light & Water Company's charges. A new schedule was put in operation recently and it is alleged that the charges for light and water are excessive in comparison with other cities similarly situated.

STRATHCONA, ALB.—A by-law to grant a franchise to the Strathcona Radial Terminal Tramway Company will be submitted to the people on Oct. 30.

REVELSTOKE, B. C.—The contract for the addition to the electric power plant has been awarded to the Canadian General Electric Company, of Montreal, for $25,762. The addition will consist of a 60-cycle, 150-kw type generator, making 600 revolutions per minute. Superintendent Holden will have charge of the construction on behalf of the city.

MORDEN, MAN.—The town has taken over the electric lighting plant here operated by a local company known as the Winnipeg Electric Company. Address S. Scott, of this town.

GRESHAM, ORE.—A surveying party is out on Oak Grove Creek, above Estacada, on the Clackamas River, surveying for a new power plant. A canal will be built for a distance of eight miles, which will give a fall of 1000 feet and will generate 40,000 horse-power. The railroad is to be extended up the Clackamas before actual construction work will commence.

HAMILTON, ONT.—At a meeting of the Board of Works held Oct. 15 Engineer Sothman, of the Hydro-Electric Power Commission, submitted a report of the cost of installing an electric light system in Hamilton, with a conduit system in the center of the city. Mr. Sothman estimated that a four-duct system would cost $57,148, and the total cost of four-duct system and 500 magnetite arc lamps with the necessary equipment was estimated at $175,580. A two-duct system would be $900 less. The cost per lamp, according to the former system, was $51.03 a year, and for the two-duct $49.70 a year. He also submitted figures showing the cost of six, eight,twelve and sixteen ducts. Mr. Southman estimated that a plant could be placed in operation within one year, and also said that the Hydro-Electric Power Commission would be in a position in a few days to state when power could be delivered from Niagara Falls.

KENORA, ONT.—The ratepayers have passed a by-law providing $75,000 for completion of the power development and water works system. Address C. S. Draper.

MANILA, P. I.—Plans and specifications are on file at the office of the ELECTRICAL WORLD, 239 West Thirty-ninth Street, New York, N. Y., for furnishing and installing electrically driven pumps and motors for the new sewerage system for the city of Manila, bids for which will be received at the office of the Municipal Board (John M. Tuther, secretary) until Jan. 15. There will be one main station and five sub-stations, each equipped with two pumps and corresponding motors, making a total of 12 pumps and motors.

MONTREAL, QUE.—The City Council has decided to advertise for tenders for supplying gas and electricity for illuminating and for heating for the city and citizens, and also for manufacturing purposes. The tenders will be received until Dec. 1 and are to be submitted separately for gas and electricity.

HUMBOLT, SASK.—Ratepayers of this town are organizing a company for the purpose of installing an electric lighting plant and telephone system and have applied for a franchise. Address Telfen Brothers.

SASKATOON, SASK.—The Saskatchewan Telephone & Electric Supply Company has been taken over by the Northwestern Telephone Company.

Company Elections.

ASHLEY, ILL.—At the annual meeting of the Ashley Telephone Company, held recently, the following officers were elected: J. A. Dycus, president; W. H. Seibert, secretary, and Henry Gilbert, treasurer.

WORCESTER, MASS.—At a meeting of the Worcester Electric Light Company, held Oct. 9, the following officers were elected: Gen. A. B. R. Sprague, Herbert H. Fairbanks, treasurer and clerk. The directors are: A. B. R. Sprague, Theodore C. Bates, Josiah Pickett, George T. Dewey, Otis E. Putnam, W. H. Coughlin, Frank L. Goes, Herbert H. Fairbanks, and John C. MacInnes.

VICTOR, N. Y.—The Ontario Mutual Telephone Company, recently organized, has elected the following officers: Dr. D. S. Partridge, of East Bloomfield, president; C. R. White, of East Bloomfield, vice-president; Robert F. Shay, of Holcomb, secretary; O. M. Dibble, of Holcomb, treasurer. The company will be capitalized at $30,000.

New Industrial Companies.

THE CENTRAL TELEPHONE & SUPPLY COMPANY, of Springfield, Ill., has been incorporated with a capital stock of $25,000 by Edward J. Novak, Sidney S. Pollack and Otto Kerner. The company proposes to manufacture telephone supplies.

THE DAVIS ELECTRIC COMPANY, of Parkersburg, W. Va., has been incorporated with a capital stock of $350,000 by J. Mentor Caldwell, Henry W. Dils, Jesse R. Davis and others. The company proposes to manufacture and deal in dynamos, batteries and other electrical machinery.

THE GLOBE ELECTRIC SPECIALTIES COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $25,000. The directors are: Harry Bessing, Robert Oppenheim and George H. King, all of New York.

THE WORKUM COMPANY, of Augusta, Maine, has been incorporated with a capital stock of $100,000 to manufacture and deal in electrical apparatus, etc. J. Berry is president and treasurer and L. A. Burleigh, clerk, both of Augusta.

New Incorporations.

RIALTO, CAL.—The Rialto Light & Power Company has been incorporated with a capital stock of $10,000 by L. E. Newcombe, A. B. Paddock, A. H. Morgan, J. C. Boyd, F. Slade, W. P. and J. F. Martin, all of Rialto.

BROWNSTOWN, IND.—The Home Telephone Company has been incorporated to build, equip and operate a telephone system and exchange in this city. The capital is $20,000. C. E. Brown, W. H. McPherson and C. F. Robertson are the directors.

BUTLERVILLE, IND.—The Harlan Telephone Company has incorporated to establish and equip a new exchange and system in this place. J. T. Sharp, E. H. Smith and E. D. Jones are the directors.

CLINTON, KY.—The Electric & Manufacturing Company has been incorporated with a capital stock of $20,000 by A. C. Moss, R. L. Johnson and Mrs. M. E. Watson, all of Clinton, Ky., and L. N. Pollock and M. D. Moss, of Campbell, Mo. The company proposes to operate electric light and power plants at Clinton, Campbell, Mo., and other places, and furnish electricity for lighting and power and establish ice and cold storage plants.

PORTLAND, ME.—The Bromfield Electric Company has been incorporated with a capital stock of $500,000. C. M. Drummond is clerk.

LOUISVILLE, MISS.—The Louisville Light & Water Company has been incorporated with a capital of $20,000 by W. L. Strong, J. L. McCracken and others.

BURLINGTON JUNCTION, MO.—The Burlington Junction Electric Light & Power Company has been incorporated with a capital stock of $6,000 by D. T. Garrett, Jesse F. Robertson, T. E. Fordyce and others.

EAST BLOOMFIELD, N. Y.—Articles of incorporation have been filed for the Ontario County Mutual Telephone Company with the Secretary of State. The company is capitalized at $30,000 and the incorporators are B. A. Partridge, O. Dibble, of East Bloomfield, and C. R. White, of Ionia.

NEW YORK, N. Y.—The Regal Electric Company has filed articles of incorporation with a capital stock of $5,000. The directors are: Albert L. Sansville, John M. Willingham and Paul Jeffrey, all of New York City.

HONESDALE, PA.—The Honesdale, Hawley & Seelyville Automobile Company has been incorporated with a capital stock of $15,000 to operate an automobile service between Hawley and Seelyville via Honesdale. Henry Buerket is president, and E. E. Fowler, George W. Conners, Fletcher Bunnell and William Taylor, directors.

MIDLAND, TEX.—The Midland Light Company has been incorporated for conducting business at this place, by E. R. Bryan, F. F. Cary, George D. Elliot and C. Harbaur.

PADUCAH, TEX.—The Paducah Telephone Company has been incorporated with a capital stock of $15,000 by J. T. Richardson and others.

PARIS, TEX.—The Texas-Oklahoma Telephone Company has been incorporated with a capital stock of $5,000 by T. A. Johnson and others.

SEATTLE, WASH.—Articles of incorporation have been filed for the Seattle-Tacoma Short Line by Merle J. Wightman, C. E. Muckler and F. J. Eitel. The company is capitalized at $6,000,000 and proposes to build a new interurban line between Tacoma and Seattle. The new company will acquire the franchises obtained in Seattle, Tacoma, Pierce and King counties for the road by Merle J. Wightman and C. E. Muckler.

PARKERSBURG, W. VA.—The Davis Electric Company has been incorporated with a capital stock of $350,000 by J. Mentor Caldwell and others.

Legal.

THREE-CENT FARES.—Judge Lawrence, of the Cleveland, Ohio, Common Pleas Court, handed down a decision last week holding illegal all franchises granted by the Council for so-called 3-cent fare lines on the East Side, except a small section constructed in East Fourteenth Street, which covers about two blocks. The court rules that the franchises for 3-cent lines on the West Side are valid, because they were granted prior to the date upon which Mayor Johnson is alleged to have become financially interested in the roads.

SOFT COAL.—Last month the Brooklyn Rapid Transit Company was made defendant in an action to stop the use of soft coal at the big power house at Kent and Division Avenues, Brooklyn. The residents of the Eastern District won a victory. It was indicted for maintaining a public nuisance, and last week the jury which has been hearing the case before Judge Fawcett in the Kings County Court brought in a verdict of guilty. Judge Fawcett granted a postponement before passing sentence. The penalty for maintaining a public nuisance is $500 fine and the absolute discontinuance of the cause of annoyance.

LIGHTING MORRISTOWN.—Chief Justice Gummere, in the Supreme Circuit Court, has granted to the Public Service Corporation a writ of certiorari to review the ordinance passed by the Morristown City Council granting a franchise to the Morris & Somerset Electric Company for furnishing the municipality with electric light. Application had been made for a writ to review not only the ordinance passed by the Council, but also the contract made by the members of the Council with the Morris & Somerset Company. The court denied the right to review the contract.

Educational.

COLUMBIA UNIVERSITY, N. Y., will offer at night during the year 1907-1908 twenty evening courses specially adapted to the needs of technical and professional workers. This includes work in applied mechanics, architecture, electricity, fine arts, industrial chemistry, mathematics, surveying and structures. The work begins Oct. 28 and continues for twenty-five weeks. A full description of the courses is contained in the "Announcement of Extension Teaching," which may be obtained on application to the director of extension teaching.

Obituary.

MR. T. H. WILLIAMS.—Mr. Thomas Hilton Williams, Sr., of Jersey City, died on Oct. 20 at his residence, 574 Bergen Avenue. He was 59 years old, and had lived in Jersey City for nearly half a century. He was president of the A. A. Griffing Iron Company and the E. A. Williams & Son Brass Foundry, both of Jersey City. He was a member of the American Society of Mechanical Engineers, the Engineers' Club, the Lawyers' Club of New York and the Cartaret Club of Jersey City.

Personal.

MR. H. B. IVERS has been appointed treasurer of the Bangor Railway & Electric Company, of Bangor, Maine.

MR. ALBERT UHL, formerly of Memphis, Tenn., has joined the sales forces of the Nernst Lamp Company, being attached to the St. Louis office.

MR. F. D. SMITH, formerly superintendent of construction for the Stevens-Hewitt Engineering Company, has resigned that position and has opened offices at 123 Liberty Street, New York, where he will carry on an electrmical contracting and specialty business.

MR. WILLIAM T. TAYLOR, M. I. E. E., superintendent Compañia Industrial Mexicana, Chihuahua, arrived in New York on the "St. Paul" last Saturday from England. He is expecting to leave here soon and extend his personal interests in Peru, South America.

MR. J. E. MONTAGUE.—We regret to note the serious illness of Mr. J. E. Montague, general manager of the Buffalo & Niagara Falls Electric Light & Power Company, who underwent an operation recently for appendicitis. A host of friends will welcome the news of his recovery.

REAR ADMIRAL G. W. MELVILLE, former engineer-in-chief of the navy and a famous hero of Arctic exploration, was married last week to Miss Estella B. Polis, of Philadelphia. The admiral has received many congratulations from the electrical field, where he has a great many friends.

MR. C. J. FIELD has been for the past two years building and operating a large sugar centrale, railway, etc., in Porto Rico and has introduced more or less electrical apparatus in connection therewith. He is now taking up similar work at Bartle, Cuba, while retaining his Porto Rico connections.

MESSRS. D. C. AND W. B. JACKSON, consulting engineers and experts, announce that they have removed their Western office from Madison, Wis., to the Commercial National Bank Building, Chicago. They have also opened an Eastern office in Boston. Mr. W. J. Crimpton is in charge of the Chicago office.

MR. HARRY PICKHARDT, who was formerly occupied in electrical construction work with the Eidlitz Company, has become associated with the Holophane Company and will devote his attention to the sale of its well-known glassware specialties. His headquarters will hereafter be with the Western sales department of the Holophane Company, Wabash Avenue, Chicago.

DR. LUCKE, professor of mechanical engineering at Columbia University, New York City, delivered a lecture on Oct. 18 before the Mechanical Society of the College of the City of New York, on "The Various Engineering Professions and the Preparation Necessary for Each." This interesting lecture was delivered in the physics lecture room in the main building.

COL. R. C. CLOWRY has just been re-elected president of the Western Union Telegraph Company—a mark of confidence in him after the recent strike. Col. Clowry was born in Will County, Ill., on Sept. 8, 1838. He received an ordinary public school education and early took up the telegraphic art. Mr. Clowry married Miss Caroline A. Estabrook on Aug. 29, 1865, at Omaha. She died in April, 1896. He is one of the powers in the telegraph and telephone corporations not only in the United States but abroad. Mr. Clowry served in the Union Army and made a gallant record during his service.

MR. WALTER B. SNOW, who has been connected for nearly 25 years with the B. F. Sturtevant Company, of Hyde Park, Mass., and has done some very successful publicity work in its behalf, has now opened offices as a "publicity engineer" at 170 Summer Street, Boston, Mass. His regular service will cover the conduct on a salary basis of the publicity departments of a limited number of non-competitive clients. Service will also be rendered to others in the form of general advertising, catalogue work, technical articles, etc. He has issued an interesting little pamphlet as to himself and what he proposes to do.

Trade Publications.

H. W. JOHNS-MANVILLE COMPANY has issued two neat four-page bulletins. One of them deals with the "Leak-No" metallic compound for stopping all manner of leaks in pipes or fittings. The great value of "Leak-No" to the user is because of its peculiar chemical action in metallizing and its power of amalgamation. During its metallizing process it expands so that it perfectly fills the leak, and as it expands equally with iron and steel, it makes a permanent repair. It is a chemical metallic compound, prepared in powder form and used by mixing with water to a stiff putty. When in this state it is a chemical plastic material that will metallize in a few hours and become a part of the casting to which it is applied. When hard it has the same color as cast iron. The other circular deals with the "J. M." cross overs and section insulators of special design and construction.

HEATING BOILER FEED.—"Heating Boiler Feed Water Where the Main Engine Is Run Condensing" is the title of a treatise recently published by the Harrison Safety Boiler Works, Philadelphia, Pa. It is shown that by using the exhaust steam of boiler feed pumps, circulating pumps and air pumps for preheating the boiler feed water the efficiency of these pumps becomes much higher than that of the best triple-expansion, condensing engine. At the same time, steam-driven machines of this character are much less expensive in first cost and the cost of attendance, are less liable to get out of order and may be operated when the main engine is standing idle. The illustrations and text cover the engineering phases of the subject, including methods of operating barometric and surface condensers, the effect of air in the condensers of steam turbine plants, description of a typical street railway power plant, etc. Copies of this booklet will be supplied upon application.

THE CENTRAL ELECTRIC COMPANY, of Chicago, Ill., is mailing out to the trade a price list dated October, 1907, which applies to the company's 1906 and 1907 general catalogue No. 24. This price list has been revised to date and contains the very latest market figures in force at this time on all electrical appliances shown in the company's catalogue. It will therefore be of considerable interest and benefit to all purchasers of electrical material, and the company requests that all holders of its catalogue who have not received a copy should write for one. In the back of the price list considerable space is devoted to the W. U. steel bracket, which is intended to replace the ordinary oak wood brackets. Attention is also called to the Central Electric Company's fixture department, a cut of a very attractive reading lamp is shown, and the company states that this department is carrying a large assortment of the most up-to-date lamps and lighting fixtures and will be glad to submit designs and quotations upon request.

Business Notes.

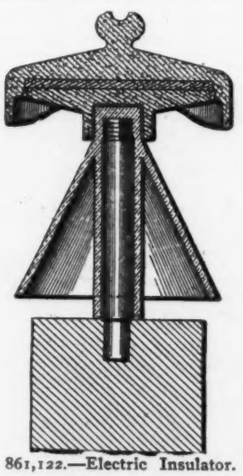
KEUFFEL & ESSER COMPANY, the well-known maker of scientific instruments, drawing materials, etc., has opened its new building in San Francisco at 48-50 Second Street, where it will carry a very large and complete stock. A special feature of the new branch will be the fine blue printing establishment.

THE CHICAGO SHOW.—In order to assist in the general publicity plans for the third electrical show in Chicago a number of the exhibitors have promised Manager Niesz to insert in their advertisements in the trade papers a line referring to their exhibit. This is a new and novel scheme of co-operation that ought to do good.

THE HELIOS MANUFACTURING COMPANY, of Philadelphia, is now ably represented in New York City by Messrs. F. S. Gassaway and L. W. Brownrigg, who have opened offices at 18 East Forty-second Street. Mr. Gassaway is very widely known among the supply men, and Mr. Brownrigg is devoting his attention particularly to the export trade. The combination is a strong one, and not only promises to be a decidedly advantageous arrangement for the Helios company, but also a great convenience to the New York dealers and contractors who desire the Helios lamps, batteries and other devices.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 15, 1907.
[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]



861,122.—Electric Insulator.

868,110.—Electric Lamp.

867,939. LINE WIRE SWITCH FROG FOR ELECTRIC RAILWAYS; Harry J. Beck, Winburne, Pa. App. filed Jan. 7, 1905. Has a plurality of splice-pieces, one of which is movable, and provided with a pivotal connection with the body part. Provides for shifting at will the angle of inclination of the main line splice-piece with respect to any branch line.

868,110. ELECTRIC LAMP; Alexander P. McArthur, Orange, N. J. App. filed Oct. 9, 1905. Form of incandescent lamp having a reflector fixed within the usual globe so as to be kept in the most efficient relation to the filament at all times.

868,122. ELECTRIC INSULATOR; Francis J. Poinan, Rochester, N. Y. App. filed July 30, 1906. In order to prevent puncture of an insulator by high potential currents, patentee has a composite structure including a layer of laminated mica.

868,123. CATAPHORIC APPARATUS; Thomas J. Randall, Los Angeles, Cal. App. filed Nov. 30, 1906. Has a plurality of plates adapted to receive the necessary medicaments, and means for adjusting said plates to various rigid frames.

868,128. ELECTRICAL MEASURING INSTRUMENT; Frank W. Roller, Plainfield, N. J. App. filed April 25, 1906. Has a movable element and springs tending to hold said element in a definite position, and a guiding element about which the movable element rotates.

868,141. FUSE BOX; John O. Stivers, Denver, Col. App. filed Oct. 26, 1906. A plurality of fuses are carried on the periphery of a rotatable block which is propelled by a ratchet device so as to place the different fuses successively in circuit closing relation.

868,171. CONTROL OF ALTERNATING-CURRENT MOTORS; Friedrich Eichberg, Berlin, Germany. App. filed Jan 26, 1907. The method of controlling an alternating current motor having a commutator and brushes short-circuiting the rotor on the line of magnetization of the stator winding, which consists in connecting the stator in series with half the rotor winding at starting by using the short-circuited brushes as one rotor terminal, and impressing a shunt excitation on the whole rotor winding when the motor is up to speed.

868,190. DYNAMO ELECTRIC MACHINE; Charles D. Knight, Schenectady, N. Y. App. filed Feb. 11, 1907. A construction of

rotor core designed to withstand the high centrifugal stresses of turbine generators. Makes use of a small central spider with lateral steel plates extended to the periphery of the rotor.

868,221. MECHANISM FOR GONGS, ETC.; Henry E. Reeve, New York, N. Y. App. filed Oct. 29, 1906. Details of an electric gong having a rotatable hammer magnetically released to strike the gong.

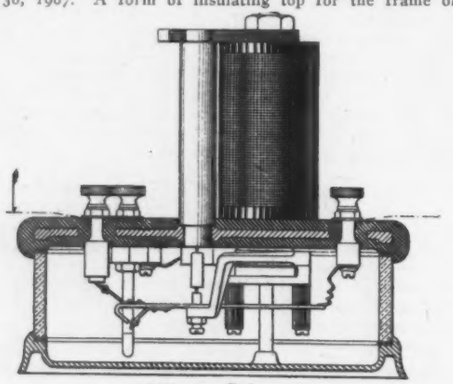
868,222. ELECTRIC RAILWAY SWITCH AND SIGNAL; Alice A. Roth, Buffalo, N. Y. App. filed May 14, 1907. A track switch device including a pair of spring plates adjacent the trolley conductor with which a circuit is completed by the trolley wheel; solenoid magnets have a lever connection with the switch point and are selectively energized according to the way the car takes current.

868,226. PRODUCTION OF MAGNESIUM; George O. Seward and Franz Von Kugelgen, Holcombs Rock, Va. App. filed Oct. 25, 1905. Process of electrolytically producing magnesium which consists in the addition to the electrolyte of so much alkali earthfluorid that the electrolyte becomes heavier than the separated magnesium.

868,230. ELECTROMAGNETIC DEVICE FOR USE IN CONNECTION WITH RAILWAY APPLIANCES; Louis H. Thullen, Edgewood Park, Pa. App. filed March 18, 1905. An indicating mechanism for a lever of an interlocking machine having a core and a coil designed to be traversed by an alternating current. Has a movable member enclosing a portion of said core and a stem connected with said movable member.

868,231. SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; Louis H. Thullen, Edgewood Park, Pa. App. filed April 30, 1907. Relates to the prevention of an improper operation of a railway signal for one track by the signaling current from an adjacent track.

868,232. RELAY; Louis H. Thullen, Edgewood Park, Pa. App. filed April 30, 1907. A form of insulating top for the frame of a telegraph relay, including sheet metal plate with a hard rubber covering, the metal being cut away at the location of the various screws, etc.



868,232.—Relay.

868,233. ELECTRIC IGNITER FOR GAS STOVES; Alfred M. Turkington, Berkeley, Cal. App. filed Sept. 25, 1906. A lever is mounted to be moved by the turning of the valve for the gas so as to swing into contact with a fixed blade or pin included in the sparking circuit.

868,245. AUDIPHONE; John A. Baker, Seguin, Texas. App. filed Aug. 1, 1904. Details of apparatus having a plurality of horns and diaphragms vibrated by electromagnets.

868,253. MANUFACTURE OF LITHOPONES BY ELECTROLYSIS; Jean B. Candau and Auguste Candau, Eaux-Bonnes, France. App. filed April 3, 1905. The process of manufacturing lithopones which consists in producing a solution of sulphate of soda and caustic soda electrolytically from the sulphate of soda and metallic zinc, and finally precipitating the sulphate of soda.

868,254. WATER ALARM APPARATUS FOR VESSELS; Francis Daniel, West Somerville, Mass. App. filed June 10, 1907. An apparatus located in the hold of a vessel to indicate the presence of water therein. Includes a float which rises to engage a push button.

868,272. SUPPORT FOR ELECTRICAL RESISTANCES. Frederick Johannsmeyer, Milwaukee, Wis. App. filed Feb. 21, 1907. Details of construction of a sheet metal box designed to enclose a resistance element.

868,283. ELECTRIC INCANDESCENT LAMP BASE; Frederic H. Manchester, Providence, R. I. App. filed Jan. 31, 1907. Construction by which the metallic sleeve at the base of an incandescent lamp is insulated from the threaded shell.

868,300. TERMINAL OR CONNECTING CLIP FOR ELECTRIC WIRES; Harry E. Sohmer and William H. Benjamin, Montclair, N. J. App. filed April 13, 1906. A metallic hook designed to form the terminal of a spark plug conductor so as to lock against jarring loose when engaged upon the plug.

868,302. SIGNALLING SYSTEM FOR RAILWAYS; Louis H. Thullen, Edgewood Park, Pa. App. filed May 28, 1906. Signal system having sectional track rails, the separate rails of a pair at a section being connected by inductive bonds. Has alternating current and polarized relays.

868,345. PROCESS OF TREATING FERRUGINOUS BLENDE; Woolsey McA. Johnson, Iola, Kans. App. filed Jan. 11, 1904. The process of producing zinc which consists in passing an electric current through a charge containing a compound of zinc and metallic iron, thereby heating the charge and reducing the compound of zinc.

868,348. DOOR OPERATED ELECTRIC SWITCH FOR ELECTRIC LIGHT CIRCUITS; John Kramer, Syracuse, N. Y. App. filed Sept. 12, 1906. The door is engaged by a spring impelled lever arm which has a mechanical connection with a knife blade switch in the arc lamp circuit.

868,354. SIGNAL SYSTEM; Bernard F. Merkel, Salida, Col. App. filed May 1, 1907. Mechanical and electrical features of a construction by which a signal is displayed directly in advance of the train to insure its observance.

868,368. WIRE SUPPORT; Louis Steinberger, New York, N. Y. App. filed Oct. 5, 1906. A form of hanger for trolley wires having a form of bayonet joint fastening between the insulator and its connected parts.

868,376. RAIL BOND; Darwin Ulke, Chicago, Ill. App. filed July 28, 1906. The rail bond is formed of flat end plates which have protuberances thereon engaging the weight of the rail and forming a space into which solder may be flowed.

868,379. SYSTEM OF ELECTRICAL DISTRIBUTION; Ezechiel Weintraub, Schenectady, N. Y. App. filed July 23, 1903. Relates to a system of operating a plurality of rectifiers by which the small extra current usually required is provided from a single rectifier of the series.

868,380. SYSTEM OF ELECTRICAL DISTRIBUTION; Ezechiel Weintraub, Schenectady, N. Y. App. filed July 23, 1903. Relates to modifications of the above.

868,381. MOTOR CONTROL SYSTEM; Harold E. White, Schenectady, N. Y. App. filed Feb. 27, 1906. A form of controller for printing press motors designed to be quickly started and stopped from a plurality of points and to operate slowly when desired.

868,387. APPARATUS FOR INCLOSING AND ELECTRICALLY CONNECTING MINERS' SAFETY LAMPS TO EFFECT ELECTRIC IGNITION; William Ackroyd, Leeds, and William Best, Albert E. Best and Robert O. Best, Morley, near Leeds, England. App. filed July 9, 1907. Details of a circuit closing device designed to avoid an electric spark in closing the circuit of a miners' lamp.

868,424. SIGNAL SYSTEM; Julien A. Gehrung, New York, N. Y. App. filed Feb. 15, 1907. A complete signal system especially adapted for steam railroads where a less expensive installation must be had than the usual block signal. Has semaphores along the track which may be selectively operated from a despatcher's station over a single wire connection. In all cases the correct actuation is checked by a return signal. There are also means by which the condition of every semaphore signal along the line is constantly shown at the despatcher's station.

868,460. COUPLING FOR ELECTRIC CABLES; Gustave L'Hoest, Brussels, and Henri Pieper, Liege, Belgium. App. filed Aug. 10, 1905. Covers a coupling for electric cables designed to separate when more than a predetermined force is put upon the cables and thereby avoid injury. Has a fabric sheathing which constitutes the part to be disrupted.

868,464. CONTROL SYSTEM; Arthur S. Mann, Schenectady, N. Y. App. filed Dec. 18, 1905. An apparatus for pumping the condensed steam in the pipes of a heating system back to the boiler whenever a predetermined amount is accumulated. Switch is closed by mechanism actuated by the weight of the water.

868,467. BRUSH HOLDER; Fred P. McBerty, Warren, Ohio. App. filed Nov. 18, 1904. A carbon brush is riveted to the flat end surface of a swinging arm having a spring connection with a part by which it is impelled angularly.

868,468. ELECTROMAGNETIC APPARATUS; John McIntyre, Jersey City, N. J. App. filed May 16, 1906. Form of vibrator for an induction coil including a small spring pressed plunger forming part of the vibrator element and attracted by the magnet pole of the core.

868,502. ARC-LAMP ELECTRODE; C. P. Steinmetz, Schenectady, N. Y. App. filed Dec. 7, 1904. Renewed July 20, 1907. An arc light electrode consisting of a mixture of a powder with granules of a more refractory material than the powder.

868,511. CABLE HANGER; Thomas A. Walsh, Yonkers, N. Y. App. filed July 23, 1907. A sheet metal stamping in the form of a strap adapted to be lapped about a cable and about the messenger wire and having ears by which the engagement is locked.

868,530. TELEGRAPH AND TELEPHONE INSULATOR; John A. Cooper, Mercury, Tex. App. filed June 18, 1907. Insulator made of porcelain with a narrow groove for the insertion of the wire and formed interiorly on somewhat the lines of a mousetrap so as to prevent the wire from escaping through said groove.

868,531. CONTROLLER OPERATING MECHANISM; Clarence T. Crocker, Norwood, Ohio. App. filed Nov. 29, 1905. The controller handle has a ratchet wheel fixed thereto which cooperates with a pawl so as to prevent a too rapid movement.

868,544. TELEPHONE ATTACHMENT; Joseph A. Gordon, Shawnee, Okla. App. filed Feb. 1, 1907. An auxiliary mouth-piece for telephones comprising a disc formed with a central opening and with a marginal flange, an inclined flange projecting from the disc in alignment with the wall of the opening, a screen covering for the inner edge of said inclined flange, and locking levers carried by the marginal flange.

868,572. SHAFT OSCILLATOR; Charles E. Lord, Norwood, Ohio. App. filed Jan. 25, 1905. Device for producing end play in shafts. A magnet is periodically energized and de-energized by a circuit breaker having carbon points and moved by a reducing gear connection from the shaft.

868,573. CONTROLLER; Charles E. Lord, Norwood, Ohio. App. filed Aug. 30, 1905. Controller for electric motor having an interlocking mechanism between the main switch and the cut-out switch of a railway controller.

868,576. POLE CHANGER; Ewing McLean, Greencastle, Ind. App. filed March 14, 1906. Mechanism for changing or alternating the polarity of an electric current adapted for telephone exchanges in connection with the polarized bells thereof. The current is derived from a battery.

868,580. DYNAMO ELECTRIC MACHINE; William D. Pomeroy, Norwood, Ohio. App. filed Jan. 2, 1906. A means for adjusting the field frames of a generator with respect to the armature so as to center the same and lock the parts in any particular adjustment.

868,581. SELF WINDING CLOCK; Arthur F. Poole, Santa Barbara, Cal. App. filed Feb. 10, 1904. Motor controlling apparatus for an electric motor used to effect the automatic winding of a clock. Has an oscillating armature and a circuit closing device independent thereof and actuated by an elastic member on the armature.

868,587. SELF WINDING ELECTRIC CLOCK; Cleaver W. Wagner, Danville, Pa. App. filed March 13, 1906. Relates to self winding clocks of that general type in which a propelling spring is placed under stress at intervals of five or six minutes through the operation of an electromagnet which serves to propel the clock train during that interval.

868,594. ATTACHMENT FOR PARTY LINE TELEPHONES; James H. Blythe, Denver, Col. App. filed May 21, 1906. Ratchet device for cutting lines not in use out of circuit and operable from central office.

868,596. POTENTIAL STARTER ATTACHMENT; Herbert W. Cheney, Norwood, Ohio. App. filed Nov. 23, 1906. Controller biased toward off position when in starting position, and means for unbiasing said controller whenever it is moved to running position.

868,621. TELEGRAPHIC INSTRUMENT; Jerome P. Zelenka, Chicago, Ill. App. filed Feb. 4, 1907. Relates to a complete telegraphic outfit strapped to the sleeve of the operator and operating to deliver the signals by a sense of touch.